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ABSTRACT

This document is designed to provide practical information for teaching the Physics 20-30 Program of Studies. The first section provides an overview of Physics 20, explaining the program philosophy and the selection and sequencing of topics. The use of concept connections and teaching a course around the science themes are described, as well as how the program articulates with the junior and senior high science courses. Section two contains four units. Unit one, "Kinematics and Dynamics", looks at the relationship among acceleration, displacement, velocity, and time. Unit two, "Circular Motion and Gravitation", emphasizes change, energy, and systems. Unit three, "Mechanical Waves" focuses on resonance. Unit four, "Light", emphasizes diversity and energy. For Physics 30, unit four (one unit) presents "Nature of Matter." The final section provides detailed information on a great variety of resources that support the implementation of this program. (ZWH)

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PHYSICS 20–30

BACKGROUND, EXEMPLARS AND RESOURCES

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PHYSICS 20–30

BACKGROUND, EXEMPLARS AND RESOURCES

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Writers

Desiree Hackman	Curriculum Standards Branch, Alberta Education
Bob Holzer	Program Consultant, Curriculum Standards Branch, Alberta Education
Pamela Shipstone	Alberta Distance Learning Centre, Alberta Education

Alberta Education, Curriculum Standards Branch

Desktop Publishing:	Shelley Gauthier Lin Gray Dianne Hohnstein Esther Yong
Administration:	Lloyd Symyrozum, Director Merv Thornton, Assistant Director Raja Panwar, Program Manager, Secondary Science Bev Romanyshyn, Project Coordinator

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PREFACE

Physics 20–30 Background, Exemplars and Resources, 1994 is designed to provide practical information for teaching the Physics 20–30 Program of Studies, which outlines what students are required to learn.

BACKGROUND

This section provides an overview of Physics 20, explaining the program philosophy and the selection and sequencing of topics. The use of concept connections and teaching a course around the science themes are described, as well as how the program articulates with the junior and senior high science courses.

EXEMPLARS

Exemplars are lesson outlines that closely follow the learning cycle set out in the specific learner expectations section of the Physics 20–30 Program of Studies. They provide models of how Physics 20 classroom activities can be structured to effectively accomplish the program objectives and include suggestions for assessment and evaluation of such activities. The strategies can be easily generalized to the Physics 30 situation.

RESOURCES

The resource lists in this section provide detailed information on a great variety of resources that support the implementation of this program. These resources include authorized teaching background resources, basic student learning resources, support learning resources for students and many other resources not authorized but deemed useful for specific parts of the Physics 20–30 program. As far as possible, resources are keyed to specific units of study. Detailed annotations, distributor information and approximate prices for each resource listed are provided.

A senior high science teacher will find it useful to have both the *Senior High Science Teacher Resource Manual,* 1992 (Interim) and the *Physics 20–30 Background, Exemplars and Resources,* 1994. The two are designed to work together, avoiding repetition of material common to all science programs.

The following documents support the senior high science curricula:

Science 16 Teacher Resource Manual, 1990 (Interim)
Science 26 Teacher Resource Manual, 1991 (Interim)
Science 14–24 Teacher Resource Manual, 1989
Senior High Science Teacher Resource Manual, 1992 (Interim)
Science 10 Teacher Resource Manual, 1992 (Interim)
Biology 20–30 Background, Exemplars and Resources, 1994
Chemistry 20–30 Background, Exemplars and Resources, 1994
Physics 20–30 Background, Exemplars and Resources, 1994
Science 20–30 Background, Exemplars and Resources, 1994

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BACKGROUND

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BACKGROUND TO THE PHYSICS 20 PROGRAM

by Bob Holzer

In the scientific enterprise knowledge is developed by progressing from concrete experiences or observations to a formal, and often abstract, generalization of phenomena, a scientific law.

Physics is the study of energy and matter and their interactions. Its scope ranges from the infinitely vast Universe to the infinitesimal particle of the substructure of the atom. As a scientific enterprise it seeks to describe and understand the physical reality. Our senses allow us to perceive the world around us, experiencing and observing natural phenomena. Through a process of raising questions, getting answers, checking answers and raising new questions we are able to develop a clearer picture of this physical world. In the scientific enterprise knowledge is developed by progressing from concrete experiences or observations to a formal, and often abstract, generalization of phenomena, a scientific law. This progression, from concrete to abstract, is reflected in the curricular design, and is the intended implementation, of Physics 20.

Selection and sequencing of topics increases the relevance of scientific principles to student's experience of the natural world.

The focus of Physics 20 is on helping the student to understand the scientific principles behind the natural events they experience and observe, and the technology they encounter in their daily lives. The program encourages enthusiasm for the scientific enterprise and develops positive attitudes about science as an interesting human activity with personal meaning. It develops in students the attitudes, skills and knowledge to help them become capable of, and committed to, setting goals, making informed choices, and acting in ways that will improve their own lives and life in their communities.

The selection and sequencing of topics in Physics 20 was influenced by the objective to increase the number of laboratory activities offered to the student, and the relevance of the scientific principles involved to the student's personal experience of the natural world. Physics 20 begins by extending the concepts studied in Unit 4 of Science 10 into two-dimensional kinematics and a formal introduction to dynamics. This traditional beginning is reasonable as, historically, mechanics was developed first, and much of what follows in physics depends on a solid understanding of mechanics. Unit 2 and Unit 3 serve as a link between mechanics and a study of the nature and behaviour of light. Placing a unit on light at the 20-level enhances the number of opportunities for laboratory activities being incorporated into the course.

The big ideas of science permeate the Physics 20 curriculum. The dominant themes in Physics 20 are change, energy and matter, while diversity, equilibrium and systems are less evident. These themes provide the teacher with a framework that can be used to link facts, theories and ideas recurring within a unit, from one unit to another, and from one course to another. Themes also serve to emphasize the links among the scientific disciplines, thus broadening the relevance of the concepts studied.

The dominant themes in Physics 20 are change, energy and matter, while diversity, equilibrium and systems are less evident.

PROGRAM ARTICULATION

Theme	Junior High	Science 10	Physics 20
Change	Motion	One-dimensional uniform motion Energy transformation	Uniform linear motion Uniform acceleration Two-dimensional motion Circular motion
Diversity		Energy and matter exist in many forms	Energy exists in many forms Light exhibits diverse properties
Energy	Thermal energy Heat and temperature Mechanical devices and energy conversions	Energy exists in many forms Potential and kinetic energy Law of conservation of energy Energy transformation	Mechanical energy Gravitational potential energy Waves transfer energy
Equilibrium	Balanced and unbalanced forces	Solar energy absorbed/lost by Earth is balanced	Static and dynamic equilibrium
Matter	Mass and weight Matter and temperature change Electrical nature of matter	Matter has mass and occupies space	Matter transmits energy as waves
Systems	Mechanical systems Electromechanical systems Electric circuits	Energy systems (input/output)	Static and dynamic physical systems

EXEMPLARS

THE RELATIONSHIP AMONG ACCELERATION, DISPLACEMENT, VELOCITY AND TIME

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Physics 20 course of studies.

Program General Learner Expectations

The **theme** emphasized is *change*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information
- identifying all variables and controls
- identifying materials and apparatus required
- formulating questions, hypotheses and/or predictions to guide research
- preparing required observation charts or diagrams

Collecting and Recording

- carrying out the procedure and modifying, if necessary
- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating

- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating data more effectively, using mathematical and statistical calculations, where necessary
- expressing measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
- communicating findings of investigations in a clearly written report

Analyzing

- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying and discussing sources of error and their affect on results
- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

Connecting, Synthesizing and Integrating

- predicting from data or information
- relating the data or information to laws, principles, models or theories identified in background information
- summarizing and communicating findings

The **STS connections** emphasized are:

- the functioning of products or processes based on scientific principles

Course General Learner Expectations

Knowledge

- compare and contrast scalar and vector quantities; and apply the concept of field to quantitatively explain, in terms of their source, direction and intensity, the gravitational effects of objects and systems
- describe, quantitatively, analyze and predict mechanical energy transformations, using the concepts of conservation of energy, work and power

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts
- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models
- interpret and analyze data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and determine new variables, using the slopes of, and areas under graphs, plot corresponding graphs, and derive mathematical relationships among the variables

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which physics and technology advance one another, using appropriate and relevant examples

Major Concept 1

Change in the position and velocity of objects and systems can be described graphically and mathematically.

Specific Learner Expectations

Knowledge

- defining, operationally, and comparing and contrasting scalar and vector quantities
- comparing and contrasting uniform and non-uniform linear motion, uniform and non-uniform acceleration, average and instantaneous velocity
- applying the concepts of slope and area under the curve to determine velocity, displacement and acceleration from position–time and velocity–time graphs

Skills

- performing experiments to demonstrate the relationships among acceleration, displacement, velocity and time, using interval timers to gather the necessary data
- inferring from a graphical analysis of empirical data the mathematical relationship among acceleration, displacement, velocity and time for uniformly accelerated motion

STS Connections

- evaluating the design of structures and devices, such as roadway approach and exit ramps, airport runways and carnival rides, in terms of kinematics principles

OR

- analyzing the use of kinematics concepts in the synchronization of traffic lights

OR

- researching and reporting on the use of kinematics principles in traffic accident investigations

Introduction

Use posters showing merging traffic on a freeway, an aircraft taking off or landing and a thrill ride to stimulate a discussion of "How does physics relate to these scenes?" Have the students make a record of their connections. These records can then be used to delineate the concepts, and their order, to be studied by the class.

Alternative: Students research the factors that traffic engineers consider when developing traffic control patterns, using synchronized traffic lights and relate them to kinematics.

Experiential Exploration

Carry out a series of activities which, using airtables or similar apparatuses, will generate displacement–time data. The activities should involve both uniform motion and uniformly accelerated motion.

Hypothesis-building

Using the empirical data gathered, generate position–time and velocity–time graphs, and those graphs in turn to determine velocity, displacement and acceleration. Remind the students of the analytical methods used to analyze similar, but more restrictive, data in Science 10. Extend the notion of determining the area under a graph to develop the mathematical relationships among acceleration, displacement, velocity and time.

Elaboration

Students perform and evaluate an experiment to determine the local value of the acceleration due to gravity, using similar data-gathering and analyzing techniques as in the Experiential Exploration phase.

Application

Have students solve problems using the concepts of kinematics graphically and algebraically. These problems should be contextualized as much as possible in the examples used in the introduction.

Significance

Analyze data from a traffic engineering department that demonstrates the application of kinematics to solve traffic flow patterns.

In areas where traffic patterns are of little or no concern, highway design or the length of a local runway (landing strip) may be analyzed from a kinematics perspective.

Debate the pros and cons of the amount of land used for roadway intersections.

An assessment of the examples used to introduce this topic may be used to indicate future concepts to be studied in order to examine their design and function.

Obtain data and information; e.g., skid mark lengths and speed from the police department, used to investigate traffic accidents.

Evaluation

- Tests, quizzes and exercises
  - use work sheets for practice and review
  - have students use data provided to, plot position–time graphs, velocity–time graphs and interpret the motion depicted by the graphs
  - have students determine velocity, displacement and acceleration
- Activities
  - prepare a written report of the laboratory exercises
  - peer evaluation of the debate on land use for roadway intersections
- Investigations
  - have students write a report of the traffic lights investigation
  - have students present an oral report of the traffic lights investigation

CIRCULAR MOTION

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Physics 20 course of studies.

Program **General Learner Expectations**

The **themes** emphasized are *change, energy* and *systems.*

The aspects of the **skills framework** emphasized are:

Initiating and Planning
- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information
- assembling and recording background information
- identifying all variables and controls
- identifying materials and apparatus required
- formulating questions, hypotheses and/or predictions to guide research
- designing and/or describing a plan for research, or to solve a problem
- preparing required observation charts or diagrams

Collecting and Recording
- carrying out the procedure and modifying, if necessary
- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating
- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating data more effectively, using mathematical and statistical calculations, where necessary
- expressing measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
- communicating findings of investigations in a clearly written report

Analyzing
- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying and discussing sources of error and their affect on results
- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

Connecting, Synthesizing and Integrating
- predicting from data or information
- proposing and explaining interpretations or conclusions
- relating the data or information to laws, principles, models or theories identified in background information
- propose solutions to a problem being investigated
- summarizing and communicating findings

Evaluating the Process or Outcomes
- establishing criteria to judge data or information
- identifying limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used

The **STS connections** emphasized are:
- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems

Course General Learner Expectations

Knowledge

- describe, quantitatively, analyze and predict with constant velocity, constant acceleration and uniform circular motion of objects and systems, using the concepts of kinematics, dynamics, Newton's laws of motion and the law of universal gravitation

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts
- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models
- interpret and analyze data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and determine new variables, using the slopes of, and areas under graphs, plot corresponding graphs, and derive mathematical relationships among the variables
- use mathematical language of ratio and proportion, numerical and algebraic methods, two-dimensional vector addition in one plane, and unit analysis to solve single- and multi-step problems; and communicate scientific relationships and concepts

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which physics and technology advance one another, using appropriate and relevant examples
- identify subject-related careers and apply the skills and knowledge acquired in Physics 20 to everyday life and to related and new concepts in subsequent studies of physics

Major Concept 1

Newton's laws of motion can be used to explain uniform circular motion.

Specific Learner Expectations

Knowledge

- describing uniform circular motion as a special case of two-dimensional motion
- solving, quantitatively, circular motion problems, using algebraic and/or graphical vector analysis
- analyzing, quantitatively, the motion of objects moving with constant speed in horizontal and/or vertical circles near the surface of the Earth

Skills

- performing experiments to determine the relationship among net force, acting on an object in uniform circular motion, frequency, mass, speed and path radius

STS Connections

- analyzing the principles of a centrifuge and its applications to solve problems in industry and research

OR

- analyzing, in terms of Newton's laws as applied to uniform circular motion, the motion of carnival rides and playground equipment moving in horizontal or vertical circles

OR

- analyzing, qualitatively, the function of a potter's wheel, in terms of Newton's laws as applied to uniform circular motion

Introduction

Swinging a small mass at the end of a cord in a horizontal circle. Ask the question: "What forces are acting on the mass?" Ask students to predict the direction of motion for the mass should the string break or be released. This prediction may be prompted by showing the class a diagram indicating potential paths the object might follow.

Discuss with the class the functioning of a number of amusement park rides using circular motion, and identify the forces involved.

OR

Examine photographs showing a shower of sparks flying from the wheel of a bench grinder. This example is complicated by the affects of gravity causing a curved path. However, by emphasizing the initial direction of the sparks, a similar discussion as with the small mass on a string demonstration can ensue.

OR

Use a photograph of a highway, or motor car race track, curve showing tire marks leaving the road to stimulate a discussion.

Experiential Exploration

The students design an activity to determine the direction of the centripetal force. Investigate the relationship among inertia, radius of curvature and speed in circular motion.

Hypothesis-building

Through guided class discussions, develop an understanding of the role of inertia in uniform circular motion, and understand that the centripetal force acts toward the centre of the path. Further, using

vector diagrams, and an understanding of kinematics, develop the notion that uniform circular motion is a special case of two-dimensional motion.

Develop the mathematical relationship among centripetal force, acceleration and period of rotation.

Elaboration

Analyze the forces acting on a pail of water swinging in a vertical circle, and determine the existing conditions that prevent spilling.

Application

The students carry out an experiment relating centripetal force to period of rotation. Using mathematical methods, provide students with an opportunity to solve circular motion problems within one or more of the STS contexts suggested in the course of studies.

Significance

Analyze carnival rides to determine the involvement of uniform circular motion in their design. Research the application of the principles of circular motion in the use of centrifuges in industry and research.

Work with clay on a potter's wheel to experience uniform circular motion in concrete terms.

Evaluation

- Tests, quizzes and exercises
  - use work sheets for practice and review
- Activities
  - prepare a written report of the laboratory exercises
- Investigations
  - have students write a report of the centrifuge investigation
  - have students present an oral report of the centrifuge investigation

RESONANCE

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Physics 20 course of studies.

Program General Learner Expectations

The **themes** emphasized are *energy* and *matter*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning
- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information
- assembling and recording background information
- identifying all variables and controls
- formulating questions, hypotheses and/or predictions to guide research
- designing and/or describing a plan for research, or to solve a problem
- preparing required observation charts or diagrams

Collecting and Recording
- carrying out the procedure and modifying, if necessary
- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating
- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating data more effectively, using mathematical and statistical calculations, where necessary
- expressing measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
- communicating findings of investigations in a clearly written report

Analyzing
- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying and discussing sources of error and their affect on results
- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

Connecting, Synthesizing and Integrating
- predicting from data or information
- identifying further problems or issues to be investigated
- identifying alternatives for consideration
- proposing solutions to a problem being investigated
- summarizing and communicating findings
- deciding on a course of action

Evaluating the Process or Outcomes
- establishing criteria to judge data or information
- considering consequences and perspectives
- identifying limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used

The **STS connections** emphasized are:
- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems

Course General Learner Expectations

Knowledge

- use the principles of simple harmonic motion and energy conservation to relate the concepts of uniform linear and circular motion to the behaviour and characteristics of mechanical waves

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts
- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which physics and technology advance one another, using appropriate and relevant examples
- explain for a given instance how science and technology are influenced and supported by society, and the responsibility of society, through physics and technology, to protect the environment and use natural resources wisely

Major Concept 1

Many vibrations are simple harmonic.

Specific Learner Expectations

Knowledge

- defining resonance, and giving examples of mechanical and/or acoustical resonance

Skills

- observing the phenomenon of mechanical and/or acoustical resonance

STS Connections

- assessing the implications of resonance in the design of structures and devices with moving parts; e.g., cars, bridges, buildings

Introduction

Ask the students to read an article, such as "Super Scrapers" in the September 1988 issue of *Discover* magazine, or an account of the Tacoma Narrows bridge collapse, and follow up with a directed discussion of the role of mechanical resonance in the design of structures.

Experiential Exploration

Using a number of demonstration apparatuses, such as coupled pendulum, resonance boxes and tuning forks, or a series of small masses (washers) tied to different lengths of string suspended from a horizontal rod or string, guide the students through an exploratory activity observing the resonance phenomenon.

Hypothesis-building

Through a guided discussion, using the observations from the Experiential Exploration activities, establish the link between resonance and the natural frequency of objects and structures. It is necessary to stress that energy is transferred in the process and that there always exists a physical link between the source of the vibration and the object resonating.

Elaboration

Investigate resonant frequencies, using an air column or sonometer demonstration, similar to those discussed in Merrill, p. 315, and Heath, p. 377, respectively, and their relationship to standing waves.

Application

Carry out an experiment to determine the speed of sound in air, using a resonating air column apparatus.

Significance

Assign the investigation of design solutions to the resonance problem as a library research project.

Ask students to investigate how designers of structures, buildings and machines, solve the problem of resonance.

Evaluation

- Tests, quizzes and exercises
  - use worksheets for practice and review
- Activities
  - prepare a written report of the laboratory exercises
- Investigations
  - have students write a report of the centrifuge investigation
  - have students present an oral report of the centrifuge investigation

REFRACTION OF LIGHT

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Physics 20 course of studies.

Program General Learner Expectations

The **themes** emphasized are *diversity* and *energy*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning
- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information
- assembling and recording background information
- identifying all variables and controls
- identifying materials and apparatus required
- formulating questions, hypotheses and/or predictions to guide research
- preparing required observation charts or diagrams

Collecting and Recording
- carrying out the procedure and modifying, if necessary
- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating
- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating data more effectively, using mathematical and statistical calculations, where necessary
- expressing measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
- communicating findings of investigations in a clearly written report

Analyzing
- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying and discussing sources of error and their affect on results
- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

Connecting, Synthesizing and Integrating
- predicting from data or information
- proposing and explaining interpretations or conclusions
- developing theoretical explanations
- relating the data or information to laws, principles, models or theories identified in background information
- proposing solutions to a problem being investigated
- summarizing and communicating findings

Evaluating the Process or Outcomes
- establishing criteria to judge data or information
- considering consequences and perspectives
- identifying limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used
- suggesting alternatives and considering improvements to experimental technique and design

The **STS connections** emphasized are:
- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems

Course General Learner Expectations

Knowledge

- describe, quantitatively, analyze and predict the behaviour of light, using the concepts of geometric and wave optics, and graphical and mathematical techniques

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts
- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models
- interpret and analyze data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and determine new variables, using the slopes of, and areas under graphs, plot corresponding graphs, and derive mathematical relationships among the variables

STS Connections

- apply cause and effect reasoning to formulate simple relationships for a given instance in which scientific evidence shapes or refutes a theory; and describe the limitations of science and technology in answering all questions and solving all problems, using relevant and appropriate examples
- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which physics and technology advance one another, using appropriate and relevant examples

Major Concept 1

Geometric optics is one model used to explain the nature and behaviour of light.

Specific Learner Expectations

Knowledge

- citing evidence for the linear propagation of light
- explaining, using ray diagrams, the phenomena of dispersion, reflection and refraction at plane and uniformly curved surfaces and dispersion
- stating and using Snell's law in the form of $n_1 \sin\theta_1 = n_2 \sin\theta_2$

Skills

- performing experiments demonstrating reflection and refraction at plane and uniformly curved surfaces
- deriving the mathematical representations of the laws of reflection and refraction, from the data obtained from these experiments

STS Connections

- evaluating and explaining technological and biological applications of linear propagation, reflection, refraction and total internal reflection of light to solve practical problems, and how these applications reflect the needs, interests and support of society; e.g., binoculars, eye-glasses, design of greenhouses, solar collectors, fibre optics

Introduction

Demonstrate refraction in a number of ways; e.g., viewing an object (pencil) through a beaker filled with water; viewing an object through a rectangular glass prism; observing a straight edge in a large container of water (aquarium); observing a coin "rise" from the bottom of a cup as it is being filled.

Display a number of optical devices; e.g., eye glasses, binoculars, optical fibre of light tube, and pose the question: "What characteristic behaviour of light observed in the demonstration makes the devices possible?" Use small group discussion.

Experiential Exploration

The students carry out a laboratory activity allowing them to conclude that light travelling from an optically less dense medium into a more dense medium is bent toward the normal; and away from the normal when moving from a more dense into a less dense medium.

Hypothesis-building

Confirm through demonstration and directed discussion the observations from the refraction activity.

Present an explanation of the phenomenon of refraction and relate it to a change in speed and wavelength.

Using semicircular glass (plastic) prisms, develop the relationship sin i/sin R = constant for a given interface.

Elaboration

Using a variety of materials (if available, semicircular transparent cells—dishes filled with different liquids) have the students determine the indices of refraction.

Application

Use the results from the elaboration utility to develop the $\sin\theta_1 n_1 = \sin\theta_2 n_2$ version of Snell's law.

Demonstrate total internal reflection and, using materials from the Elaboration activity, lead students to the relationship between the index of refraction and the critical angle.

Solve refraction problems graphically, using ray diagrams and/or algebraically.

Significance

Students investigate how the phenomenon of refraction and the nature of the medium (optical density, index of refraction are responsible for the functioning of binoculars, optical fibres, etc. Have students research fibre optics applications and prepare a report.

Evaluation

- Test, quizzes and exercises
  - use work sheets for practice and review
  - have students to draw ray diagrams indicating the path of light through a variety of interfaces
- Activities
  - have students prepare a written report of the Snell's law experiment
- Investigations
  - have students write a report of the fibre optics investigation
  - have students present an oral report of the fibre optics investigation

RADIATION PHENOMENA AND TECHNOLOGY IN INDUSTRY AND RESEARCH

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Physics 30 course of studies.

Program General Learner Expectations

The **themes** emphasized are *change, energy* and *matter.*

The aspects of the **skills framework** emphasized are:

Initiating and Planning
- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information
- assembling and recording background information
- formulating questions, hypotheses and/or predictions to guide research
- designing and/or describing a plan for research, or to solve the problem
- preparing required observation charts or diagrams

Organizing and Communicating
- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating findings of investigations in a clearly written report

Analyzing
- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

Connecting, Synthesizing and Integrating
- predicting from data or information
- identifying further problems or issues to be investigated
- identifying alternatives for consideration
- proposing and explaining interpretations or conclusions
- summarizing and communicating findings
- deciding on a course of action

Evaluating the Process or Outcomes
- establishing criteria to judge data or information
- considering consequences and perspectives
- identifying limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used
- evaluating and assessing ideas, information and alternatives

The **STS connections** emphasized are:
- the central role of experimental evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the use of technology to solve practical problems

Course General Learner Expectations

Knowledge

- explain, citing empirical evidence, the development of an atomic theory contingent upon wave-particle duality of matter and statistical probability and its technological application

Skills

- perform and evaluate investigations and tasks of their own and others' design that have multiple variables and yield direct or indirect evidence; and provide explanations, using scientific theories and concepts
- collect, verify and organize data into tables, graphs and diagrams of their own design, using written and symbolic forms; and describe findings or relationships, and make predictions, using scientific vocabulary, notation, theories and models

STS Connections

- apply cause and effect reasoning to formulate relationships for a range of instances in which scientific evidence shapes or refutes a theory; and explain the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples
- describe and evaluate the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which physics and technology advance one another, using appropriate and relevant examples
- explain and evaluate for a given instance and from a variety of perspectives, how science and technology are influenced and supported by society; and assess the ability and responsibility of society, through physics and technology, to protect the environment and use natural resources wisely
- identify subject-related careers and apply the skills and knowledge acquired in Physics 30 to everyday life and to related and new concepts in post-secondary studies of physics.

Major Concept 3

Nuclear fission and fusion are nature's most powerful energy sources.

Specific Learner Expectations

Knowledge

- explaining, qualitatively, how radiation is absorbed by matter, and compare and contrast the biological effects of different types of radiation.

Skills

- inferring radiation properties from experimental data provided

STS Connections

- evaluating the applications of radiation phenomena and technologies to solve practical problems in research, medicine, agriculture, industry; e.g., isotope tracing, food irradiation

Introduction

For several weeks in advance of this unit, ask the students to search for, read and collect current newspaper and magazine articles dealing with the use of radiation phenomena and technologies in agriculture, industry and medicine. In small groups, examine these articles for emerging issues and the perspectives represented; e.g., social, economic, scientific, technological. Use charts and/or tables to organize the information gathered.

Alternatively, assign the use of radiation phenomena and technologies in agriculture, industry and medicine as a library research project, and have the students prepare a report, either as individuals or in small groups.

OR

Assign selected articles to be read and analyzed; e.g., "The Use of Radiation in Medicine" by Brian Lentle in the *Pugwash* 1991 STS yearbook.

Experiential Exploration

Arrange for a guest speaker who could address one of the following topics:

- use of radiation in diagnosis, treatment or research in medicine
- use of isotope tracing or X-ray technology in pipeline inspections
- hydrological survey using isotope tracing to track ground water flow
- agricultural research into food irradiation

Hypothesis-building

Through guided class discussions, using information collected to this point, identify the properties of the radiation used in the various applications explored, and develop an understanding of the relationship between the degree of exposure to various radiation phenomena and the risks involved.

Elaboration

Conduct an investigation to determine how the intensity of radiation varies with distance from the radioactive source, using an experimental design similar to Merrill's Experiment 30.1.

Application

Compare and contrast the characteristics and levels of radiation used in industry and research to the natural radiation occurring on Earth. Follow this up with a discussion of how these characteristics influenced the reporting of events, or issues, in the articles collected for this unit.

Significance

Divide the class into two or three groups. Ask them to prepare a risks/benefits analysis of the use of radiation phenomena and technology in industry and research for presentation to the public.

OR

Organize a debate of the pros and cons of the use of radiation phenomena and technology in industry and research.

Evaluation

- Tests, quizzes and exercises
  - marks may be assigned for the organization of the information gathered for the introductory activity
- Activities
  - use a peer evaluation of the risks/benefit analysis, or the debate
- Investigations
  - have students write a report of the library research conducted.

RESOURCES

BEST COPY AVAILABLE

RESOURCES OVERVIEW

by Desiree Hackman and Pamela Shipstone

The following is a list of resources useful for implementing the Physics 20–30 program. This resource list is divided into the following sections:

Physics 20 Major Concepts with Resource Listings (by Unit)
Physics 30 Major Concepts with Resource Listings (by Unit)
Physics 20–30 Basic Student Learning Resources
Physics 20–30 Authorized Student Support/Teaching Resources
Other Learning Resources: General
- Laboratory Interfaces
- Software
- Videodiscs
- Teacher Background

Other Learning Resources: Physics 20 (by Unit)
Other Learning Resources: Physics 30 (by Unit)
Distributor Addresses (alphabetical)

Basic student learning resources are those student learning resources authorized by Alberta Education as the most appropriate for addressing the majority of learner expectations of the course(s), substantial components of the course(s), or the most appropriate for meeting general learner expectations across two or more grade levels, subject areas or programs as outlined in provincial programs of study. These may include any resource format, such as print, computer software, manipulatives or video.

Support student learning resources are those student learning resources authorized by Alberta Education to assist in addressing some of the learner expectations of course(s) or components of course(s); or assist in meeting the learner expectations across two or more grade levels, subject areas or programs as outlined in the provincial programs of study. They may include any resource format, such as print, computer software, manipulatives or video.

Authorized teaching resources are those teaching resources produced externally to Alberta Education (for example, by publishers) that have been reviewed by Alberta Education, found to meet the criteria of review and to be the best available resources to support the implementation of programs of study and courses, and the attainment of the goals of education; they have been authorized by the Minister. Teaching resources produced as service documents by Alberta Education, such as the *STS Science Education: Unifying the Goals of Science Education*, 1990 monograph, and diagnostic programs, are authorized by definition.

Other learning resources are those learning resources identified by Alberta Education as useful for teachers in the implementation of a course(s) or program(s) of studies, but which have not undergone review procedures by Alberta Education. Alberta Education does not accept responsibility for use of these resources with students. It is the responsibility of the teacher to determine their suitability and application.

When searching for resources to support the science program you may want to check:

- Other departments within your school. Often, resources are useful for ideas in more than one subject area. For example, Junior High Science, Environmental and Outdoor Education (EOE), Social Studies, Career and Life Management (CALM), or English.
- School library for print or nonprint resources.
- ACCESS Network for many authorized teaching and support video resources.
- LRDC for most authorized teaching and support print resources and some nonprint resources.
- Government and nongovernment agencies for print and nonprint educational materials and/or background information.
- Distributor for print and nonprint resources.

Basic student learning resources are available through the Learning Resources Distributing Centre (LRDC). A *Buyers Guide* is also available.

Learning Resources Distributing Centre
12360 - 142 Street
Edmonton, Alberta
T5L 4X9
Telephone (403) 427-2767

Note: The information included is the most recent available at the time of document preparation. Prices of resources are as provided by distributors, May 1993. Check with distributor for current rates.

UNIT 1: KINEMATICS AND DYNAMICS

A – Authorized Section
O – Other Section, Physics 20:
• by Unit
★ – Nonprint
● – Print

1. Change in the position and velocity of objects and systems can be described graphically and mathematically.

O●Exploration Science Snackbook (The)
O★Force and Motion: Newton's Three Laws
O★Quad 1: Physics in Earth and in the Heavens: The Mechanical Universe Series
O★Quad 3: Kinematics and Scientific Methods: The Mechanical Universe Series
O●Survival of Physics: Problem Solving in Newtonian Mechanics
O●Turning the World Inside Out
O★Vectors
O★Vectors: The Mechanical Universe Series

2. The concepts of dynamics explicitly relate forces to change in velocity.

O★Force and Motion: Newton's Three Laws
O★Inertia: The Mechanical Universe Series
O★Law of Falling Bodies (The): The Mechanical Universe Series
O★Laws of Motion Applied (The): Physics in Action Series
A★Newton's First Law: Conceptual Physics with Hewitt Series
O★Newton's Laws: The Mechanical Universe Series
A★Newton's Third Law: Conceptual Physics with Hewitt Series

3. Work is a transfer of energy.

O●Survival of Physics: Problem Solving in Newtonian Mechanics

UNIT 2: CIRCULAR MOTION AND GRAVITATION

A – Authorized Section
O – Other Section, Physics 20:
• by Unit
★ – Nonprint
● – Print

1. Newton's laws of motion can be used to explain uniform circular motion.

O★Going Around in Circles
O★Moving in Circles: The Mechanical Universe Series
O●Survival of Physics: Problem Solving in Newtonian Mechanics

2. Gravitational effects extend throughout the Universe.

A★Apple and the Moon (The): The Mechanical Universe Series
O★Kepler Problem (The): The Mechanical Universe Series
O★Kepler's Three Laws: The Mechanical Universe Series
O★Microgravity: Space Education Series
O★Quad 1: Physics in Earth and in the Heavens: The Mechanical Universe Series

UNIT 3: MECHANICAL WAVES

A – Authorized Section
O – Other Section, Physics 20:
• by Unit
★ – Nonprint
● – Print

1. Many vibrations are simple harmonic.

O★Harmonic Motion (Visual Education Centre)
A★Harmonic Motion: The Mechanical Universe Series
A★Physics of Music: The Nature of Vibrations and Sound
A★Properties of Waves (Non-light)
O★Quad 1: Harmonic Motion: Physics in Earth and in the Heavens: The Mechanical Universe Series
O★Sound, Music and Noise: Science in Focus Series
O●Survival of Physics: Problem Solving in Newtonian Mechanics

2. Waves are a means of transmitting energy.

O●Energy Control and Communication: Pathways Through Science Series
O★Resonance: The Mechanical Universe Series
O★Sound, Energy and Wave Motion: Physical Science Series
A★Superposition of Waves: Program 10: Senior High Science Series
O★Waves: The Mechanical Universe Series
O★Waves and Sound

UNIT 4: LIGHT

A - Authorized Section
O - Other Section, Physics 20:
• by Unit
★ - Nonprint
● - Print

1. Geometric optics is one model used to explain the nature and behaviour of light.

O★Behaviour of Light (The)
O★Convex and Concave Lenses: Introductory Concepts in Physics Series
A★Fibre Optics (ACCESS Network)
O★Fibre Optics (Marlin Motion Pictures Ltd.)
O★Quad 7: The Wave Nature of Light: The Mechanical Universe Series

2. The wave model of light improves our understanding of the behaviour of light.

O★Electromagnetic Model (The): Wave Particle Duality Series
O★Interference of Light
O★Optics: Beyond the Mechanical Universe Series
O★Particle Model (The): Wave Particle Duality Series
O★Polarization of Light: Evidence of Wave: Nature of Light Series
O★Polarized Light: Introductory Concepts in Physics Series
O★Polarized Light and 3-D Viewing
A★Thin Film Interference: Program 11: Senior High Science Series
O★Wave Model (The): Wave Particle Duality Series

UNIT 1: CONSERVATION LAWS

A – Authorized Section
O – Other Section, Physics 30:
• by Unit
★ – Nonprint
● – Print

1. Conservation of energy in a closed system is a fundamental physical concept.

O★Quad 2: Conservation of Energy: Conservation Laws and Fundamental Forces: The Mechanical Universe Series
O★Quad 2: Fundamental of Forces (The): Conservation Laws and Fundamental Forces: The Mechanical Universe Series

2. Momentum is conserved when objects interact in a closed system.

O★Collisions
A●Conceptual Physics: The High School Physics Program, Second Edition
O★Conservation of Momentum: The Mechanical Universe Series
O★Quad 2: Angular Momentum: Conservation Laws and Fundamental Forces: The Mechanical Universe Series
O★Quad 2: Conservation of Momentum: Conservation Laws and Fundamental Forces: The Mechanical Universe Series
O★Quad 2: Fundamental of Forces (The): Conservation Laws and Fundamental Forces: The Mechanical Universe Series
O●Turning the World Inside Out

UNIT 2: ELECTRIC FORCES AND FIELDS

A – Authorized Section
O – Other Section, Physics 30:
• by Unit
★ – Nonprint
● – Print

1. The concepts of electrostatics are used to explain the behaviour of electric charges at rest.

O★Potential and Capacitance: Beyond the Mechanical Universe Series
O★Static and Current Electricity: Physical Science Series
O★Static Electricity: Beyond the Mechanical Universe Series
O★Voltage, Energy and Force: Beyond the Mechanical Universe Series

2. Coulomb's law relates electric charge to electric force.

O★Quad 5: Electric Fields and Forces: The Mechanical Universe Series
O★Static Electricity: Beyond the Mechanical Universe Series

3. Electric field theory is a model used to explain how charges interact.

O★Electric Battery: Beyond the Mechanical Universe Series
O★Electric Field (The): Beyond the Mechanical Universe Series
O●Electricity: Pathways Through Science Series
O★Quad 5: Electric Fields and Forces: The Mechanical Universe Series

4. Electric circuits facilitate the use of electric energy.

O★Electric Battery: Beyond the Mechanical Universe Series
O★Electric Circuits: Beyond the Mechanical Universe Series
O★Electric Currents and Circuits: Physical Science Series

UNIT 3: MAGNETIC FORCES AND FIELDS

A – Authorized Section
O – Other Section, Physics 30:
• by Unit
★ – Nonprint
● – Print

1. Magnetic field theory is a model to describe magnetic behaviour.

O●Electricity: Pathways Through Science Series
O★Magnetic Field (The): Beyond the Mechanical Universe Series
O★Magnetic Fields: Experiment: Physics: Level 1 Series
O★Magnets: Beyond the Mechanical Universe Series
O●Superconductivity Primer
O★Ultra-strong Magnetic Fields: The World of Extremes Series

2. Electromagnetism pervades the Universe.

O★Alternating Current: Beyond the Mechanical Universe Series
O★Electricity and Magnetism: Physical Science Series
O★Electromagnetic Induction: Beyond the Mechanical Universe Series
O★Electromagnetism, Part 1: Electric Fields, EM Fields, Motor Effect
O★What Einstein Never Knew

3. Electromagnetic radiation is a physical manifestation of the interaction of electricity and magnetism.

O★Electromagnetism, Part 1: Electric Fields, EM Fields, Motor Effect
O★Gravity, Electricity and Magnetism: The Mechanical Universe Series

UNIT 4: NATURE OF MATTER

A - Authorized Section
O - Other Section, Physics 30:
• by Unit
★ - Nonprint
● - Print

1. The atom has an electrical nature.

O★Atom (The): Beyond the Mechanical Universe Series
O★Electron Arrangement in Atoms
O★Sheldon Glashow: Unifying Forces: Nobel Prize Series
O★Smaller than the Smallest: Structure of the Atom Series

2. The photoelectric effect requires the adoption of the photon model of light.

O★Electromagnetic Model (The): Wave Particle Duality Series
O★Matter Waves: Wave Particle Duality Series
O★Particle Model (The): Wave Particle Duality Series
O★Photons: Wave Particle Duality Series
O★Quantum Idea (The): Wave Particle Duality Series
O★Sheldon Glashow: Unifying Forces: Nobel Prize Series
O★Wave Mechanical Model (The): Structure of the Atom Series
O★Wave Model (The): Wave Particle Duality Series

3. Nuclear fission and fusion are nature's most powerful energy sources.

O★Atomic Particles: Women in Science Series
O★Can We Use It? The Story of Radiation Series
O★Cold Fusion
O★Discovery of Radioactivity (The): Nuclear Physics Series
O★Does It Affect Us? The Story of Radiation Series
O★Electrical Energy from Fission: Nuclear Physics Series
O★Energy from the Nucleus: Nuclear Physics Series
O★Four Forces of Nature (The): Science Show Series
O★Is It Safe? The Story of Radiation Series
O★Natural Transmutations: Nuclear Physics Series
O★Nature of Radioactivity (The): Experiment Physics: Level 2 Series
O★Nuclear By-products: Nuclear Physics Series
O★Nuclear Energy
O★Nuclear Physics
O●Nuclear Physics
O★Nuclear Science: Women in Science Series
O★Nuclear Waste Management: Science Screen Report Series
O★Properties of Becquerel Rays: Nuclear Physics Series
O★Radioactivity: Science Topics
O●Science, Technology and Society
O★What Does It Do? The Story of Radiation Series
O★What Effect Does It Have? The Story of Radiation Series
O★What Is It? The Story of Radiation Series
O★What Is It Made Of? The Story of Radiation Series
O★What Is Radioactivity?
O★Where Is It? The Story of Radiation Series

4. Energy levels in nature support modern atomic theory.

O★Bohr Model (The): Structure of the Atom Series
O★Earliest Models (The): Structure of the Atom Series
O★Electron Arrangement: Electron Arrangement and Bonding Series
O★Introducing the Players
O★Niels Bohr
O★Rutherford Model (The): Structure of the Atom Series
O★Rutherford Scattering of Alpha Particles: Experiment: Physics: Level 2 Series
O★Rutherford-Bohr Atom (The): Electron Arrangement and Bonding Series
O★Sheldon Glashow: Unifying Forces: Nobel Prize Series
O★Spectra: Structure of the Atom Series

Basic Student Learning Resources

Physics 20 and Physics 30

Fundamentals of Physics: A Combined Edition, 1992

Format	Text	ISBN 0669953415
Annotation	A basic learning resource for Physics 20–30 covering the knowledge, skills and many of the suggested science–technology–society connections in the program of studies. The text contains sample and practice problems that provide examples of the application of physical principles. The investigations are designed to be done by students; the materials are listed and the steps numbered.	
Price	$53.60	
Author	David A. Martindale et al.	
Publisher	D. C. Heath Canada Ltd.	
Distributor	LRDC	140492

Merrill Physics: Principles and Problems: Canadian Edition, 1992

Format	Text	ISBN 0029541255
Annotation	A basic learning resource for Physics 20–30 covering the knowledge, skills and many of the suggested science–technology–society connections in the program of studies. The text contains an outline of the major objectives in each chapter, a review of concepts and their applications, as well as laboratory and problem-solving opportunities for students.	
Price	$50	
Author	Paul W. Zitzewitz, Mark Davids and Robert F. Neff	
Publisher	Maxwell Macmillan Canada	
Distributor	LRDC	140509

Physical Science: Principles of Physical Science: The Living Textbook Series, 1987

Format: Videodiscs

Annotation: A two-videodisc set, this program provides more than 2500 slides, 300 diagrams, a 325-term visual glossary and 90 movie clips surveying physical science. Movie clips cover the structure of matter, including atomic theory and radioactivity; states of matter, including solids, liquids and gases; the conservation of energy; mechanics, including Newton's and Kepler's laws with examples; wave motion; light and sound, including refraction, polarization and energy levels; electricity and magnetism, including an electrochemical cell, magnetization, electromagnetics and aurorae observations. Matter, motion and forces are covered on sides 1 and 2 and waves, electricity and magnetism on sides 3 and 4.

Both videodiscs have curricular fit to Science 10, Chemistry 20–30, Physics 20–30 and Science 20–30.

Price: $1175

Distributor: LRDC 242876

Physics: Cinema Classics, 1992

Format: Videodisc

Annotation: The American Association of Physics Teachers (AAPT) conceived the idea of collecting classic physics films used by thousands of teachers for decades. They contain demonstrations and laboratory experiments applicable to the current Physics 20–30 Program of Studies. D. C. Heath Canada is planning a teacher's guide for this text.

Features:

- 248 chapters organized by physics principles
- almost 2000 video segments and/or still images
- over 290 000 individual frames in the 2000 segments/images
- on-screen instructor's hints for each chapter
- uses two audio tracks, with discussion and explanation narrative accompanying most video segments
- on-screen graphics

Side A: Mechanics
Side B: Mechanics II and Heat
Side C: Waves
Side D: Waves II and Electricity and Magnetism
Side E: Conservation Laws
Side F: Angular Momentum and Modern Physics

Price: $969.10

Distributor: LRDC 255374

Authorized Student Support/Teaching Resources

Apple and the Moon (The): The Mechanical Universe Series, 1985 **Physics 20**

Format	Video (29 minutes)
Annotation	*(Authorized Student Support)*
	Seeking an explanation for Kepler's theories, Newton discovered that gravity describes the force between any two particles in the Universe. Newton's universal law of gravity reveals why an apple, but not the moon, falls to the Earth.
Price	Contact distributor
Distributor	ACCESS Network VC291408

Asimov's Chronology of Science and Discovery, 1989 **Physics 20–30**

Format	Print ISBN 0060156120
Annotation	*(Authorized Teaching Resource)*
	From 4 000 000 BCE to the present, the significant events in astronomy, exploration, biology, physics, chemistry and mathematics are described. Asimov illustrates how scientific, cultural, social and political events affected each other. Discoveries and inventions are categorized by year of discovery against a backdrop of world history, and show how science influenced the world and how the world has responded to scientific advances.
Price	$28.55
Author	Isaac Asimov
Distributor	LRDC 261412

Career Connections Series, 1993 **Physics 20–30**

Format: Print

Annotation: (*Authorized Student Support*)

Summary: This series outlines the educational background needed to qualify for different careers in a variety of areas. Personal profiles and comments from individuals are featured.

Great Careers for People Interested in How Things Work
Author: Peter Richardson and Bob Richardson ISBN 1895579082

Describes careers such as: inventor, chemical research analyst, automotives mechanic.

Great Careers for People Interested in the Human Body
Author: Lois Edwards ISBN 1895579066

Describes careers such as: family physician, respiratory technologist, community health nurse.

Great Careers for People Who Like Being Outdoors
Author: Helen Mason ISBN 1895579104

Describes careers such as: park naturalist, practical forester, farmer.

Great Careers for People Concerned About the Environment
Author: Lesley Grant ISBN 189557904X

Describes careers such as: environmental chemist, lawyer, health specialist.

Great Careers for People Interested in Math and Computers
Author: Peter Richardson and Bob Richardson ISBN 1895579023

Describes careers such as: mathematics consultant, video games programmer, audio engineer.

Great Careers for People Interested in Living Things
Author: Julie Czerneda ISBN 1895579007

Describes careers such as: plant scientist, museum biologist, equestrian coach.

Price: Contact distributor

Distributor: LRDC

Conceptual Physics: The High School Physics Program, Second Edition, 1992 **Physics 20–30**

Format: Print ISBN 0201286513

Annotation: (*Authorized Student Support*)

Physics is treated conceptually rather than mathematically. Concepts are outlined in detail, and equations are used as guides for thinking, rather than recipes for algebraic problem solving.

Price: $48.20

Author: Paul G. Hewitt

Distributor: LRDC 238396

Format: Six, 10-minute videos

Annotation: (*Authorized Student Support*)

Summary: Covers the fundamentals of electrostatics and current electricity, and explores different causes and effects of electricity.

Conductors and Insulators VC300901
Establishes some of the fundamental principles of electrostatics, such as the two types of electrostatic charge: negative and positive. Illustrates electron flow in charged particles at the atomic level.

Charging and Discharging VC300902
Examines the following electrostatic laws: like charges repel, unlike charges attract, and a charged object attracts a neutral object. Shows what happens when an electrically charged object is grounded. Demonstrates how a metal leaf electroscope functions.

Charging by Induction VC300903
Reviews the concepts of charging by contact and discharging by grounding. Illustrates how a charged rod affects an electroscope. Demonstrates one application of charging with a simulation of the action of lightning during a thunderstorm.

Current Electricity VC300904
Examines how a flow of electric charge is harnessed when an electrostatically charged object is grounded. Introduces a dry cell or "battery" as a source of current electricity. Illustrates the concepts of complete circuits, their energy conversions, electrical currents, and the ampere.

Potential Difference VC300905
Introduces additional concepts needed for the complete description of an electrical current. Uses the analogy of a ski lift and skiers to demonstrate changes in gravitational potential energy and changes in electrical potential energy. Explains the volt as a unit for potential difference.

Resistance VC300906
Focuses on a simple circuit. Introduces the concept of resistance, or relative differences in conductivity, which is explained in terms of varying numbers of free electrons and pathways for electron flow. Concludes with a caution to viewers to beware of electricity's potential hazards.

Price: Contact distributor

Distributor: ACCESS Network

Electromagnetism Series, 1988 **Physics 30**

Format: Six, 10-minute videos

Annotation: (*Authorized Student Support*)

Summary: Explains the historic discovery of the Earth's magnetic field. Examines this force as it applies to electromagnetic induction, the motor principle, generators and transformers. Applies modern theories about the Earth's magnetic field to the extinction of species and to the ways in which animals use it for navigation.

Earth's Magnetic Field VC301201
Provides a chronology of the discoveries made about the properties of lodestone, from the initial discovery that lodestone had a mysterious attraction to iron, to the conclusion that the Earth itself is a huge magnet.

Magnetism and Electron Flow VC301202
Introduces the left-hand rule for predicting the relationship between the direction of the magnetic field and the direction of the electron flow in a conductor. Demonstrates the extended magnetic field surrounding a helix.

Domain Theory VC301203
Examines the electromagnet and illustrates the relative conductivity of various metals at the atomic level. Reviews the left-hand rule. Shows the way that atoms of metals, such as iron and steel, arrange themselves in domains.

The Motor Principle VC301204
Introduces the motor principle by using the analogy of a futuristic magnetic rail gun. Shows current flowing through a simple loop of wire within an external magnetic field, causing the loop to rotate partially. Adds a split-ring commutator to achieve continuous rotation.

Electromagnetic Induction VC301205
Tells how, in 1830, British scientist, Michael Faraday, discovered the principle of electromagnetic induction. Demonstrates this along with Lenz's law that the inducted magnetic field always opposes the changing external magnetic field.

Life in the Field VC301206
Illustrates the effects of Earth's magnetic field on all forms of life. Looks into the theory that many animals become extinct as a result of occasional reversals of Earth's magnetic field. Examines how animals use Earth's magnetic field for navigation.

Price: Contact distributor

Distributor: ACCESS Network

Fibre Optics, 1988 **Physics 20**

Format: Video (20 minutes)

Annotation: (*Authorized Student Support*)

Examines the scientific revolution brought on by a glass fibre, thinner than a human hair. Shows how fibres are made and their applications in communications where their capacity has led to rapid use in voice and data transmission.

Price: Contact distributor

Distributor: ACCESS Network

Fundamentals of Physics: A Combined Edition: Teacher's Manual, 1993 **Physics 20–30**

Format: Print ISBN 0669953407

Annotation: (*Authorized Teaching Resource*)

A comprehensive resource package correlating with the basic authorized text for Physics 20–30: *Fundamentals of Physics: A Combined Edition*, 1992. Contains teaching strategies and lesson plans.

Price: $75

Author: David G. Martindale, Robert W. Heath and Philip C. Eastman

Distributor: LRDC 239112

Georg Bednorz: Exploring Superconductivity: Nobel Prize Series, 1990 **Physics 30**

Format: Video (15 minutes)

Annotation: (*Authorized Student Support*)

The program on Georg Bednorz includes an interview with the laureate, a student notebook providing an overview of his life and research on superconductors and a teacher resource book. Bednorz explains the role of curiosity in his career and the excitement he feels in his work as a scientist. The story of his breakthrough in high temperature superconductivity also reveals how science works: by increments, scientists build on the research of others until a combination of insight, diligence and luck can lead to significant discoveries.

Price: $70.30

Distributor: LRDC 240929

Harmonic Motion: The Mechanical Universe Series, 1985 **Physics 20**

Format: Video (30 minutes)

Annotation: (*Authorized Student Support*)

The restoring force and inertia of any stable mechanical system causes objects to execute simple harmonic motion, a phenomenon that repeats itself in perfect time.

Price: $99
$89/copy for 25 copies
$79/copy for 50 copies

Distributor: Magic Lantern Communications Ltd.

Heath Physics: Computer Test Bank, 1993 **Physics 20–30**

Format: Courseware/Print
MS–DOS ISBN 0669167533 (Archive III)
0669228370 (Archive III Manual)
Test Bank: 0669257974
Teacher's Guide

Annotation: (*Authorized Teaching Resource*)

A resource package correlating with the basic authorized text for Physics 20–30: *Fundamentals of Physics: A Combined Edition,* 1992. Contains questions that may be useful in test construction.

Price: $56.60 Teacher's Guide

Distributor: D. C. Heath Canada Ltd.
LRDC 239211 (teacher's guide)

Heath Physics: Laboratory Manual: Student Version, 1992 **Physics 20–30**

Format: Print ISBN 0669257958

Annotation: (*Authorized Student Support*)

A laboratory manual to accompany the basic authorized text for Physics 20–30: *Fundamentals of Physics: A Combined Edition,* 1992. It contains a variety of laboratory investigations correlating with the Physics 20–30 Program of Studies.

Price: $12.35

Author: David G. Martindale et al.

Distributor: LRDC 239146

Heath Physics: Laboratory Manual: Teacher's Edition, 1993 **Physics 20–30**

Format	Print	ISBN 0669257966
Annotation	(*Authorized Teaching Resource*)	
	A resource package correlating with the basic authorized text for Physics 20–30: *Fundamentals of Physics: A Combined Edition,* 1992.	
Price	$15.30	
Author	David G. Martindale et al.	
Distributor	LRDC	239120

Heath Physics: Overhead Transparencies with Worksheets, 1993 **Physics 20–30**

Format	Print	ISBN 0669266574
Annotation	(*Authorized Teaching Resource*)	
	A resource package correlating with the basic authorized text for Physics 20–30: *Fundamentals of Physics: A Combined Edition,* 1992.	
Price	$222.95	
Distributor	LRDC	239138

Invitations to Science Inquiry, Second Edition, 1992 **Physics 20**

Format	Print	ISBN 187810621X
Annotation	(*Authorized Teaching Resource* for *Science 10* and *Science 20–30*)	
	Discrepant events are set up in such a way as to pose questions and ask for explanations. The description of discrepant events is organized to provide guidance for conducting a science inquiry. Emphasis has been placed on the use of simple material so that most of the events can be carried out with things that are found in everyday life or can be bought in local stores.	
Price	$56	
Author	Tik Liem	
Distributor	LRDC	242313

Merrill Physics: Principles and Problems, 1992 **Physics 20–30**

Format: Print
Study Guide ISBN 0675172780
Laboratory Manual 0675172683

Annotation: (*Authorized Student Support*)

This resource contains two components for student reference, questions for study purposes, and laboratory investigations. It complements the basic textbook for Physics 20–30, *Merrill Physics: Principles and Problems: Canadian Edition*, 1992.

Price: $10.75 Study Guide
$11.70 Laboratory Manual

Author: Craig Kramer and Paul Zitzewitz

Distributor: LRDC 239154 (study guide)
239203 (laboratory manual)

Merrill Physics: Principles and Problems, 1992 **Physics 20–30**

Format	ISBN	Price	LRDC
Teacher Resource Package (print)	0675164664	$424.15	239162
Problems and Solutions Manual (print)	067517273X	$20.10	239196
Laboratory Manual: Teacher Edition (print)	0675172691	$19.45	239188
Computer Test Bank (Apple IIe, IIc, IIGS Version) (courseware)	0675024846	$15.45	239279
(test bank manual)	0675164656		

Annotation: (*Authorized Teaching Resource*)

This resource contains components correlating with the Physics 20–30 Program of Studies. It includes a variety of activities, exercises and ideas for test questions, as well as methods and materials for teaching the Physics 20–30 course. This resource complements the basic textbook *Merrill Physics: Principles and Problems: Canadian Edition*, 1992.

Author: Daniel Spears, Donald Wilke and Paul W. Zitzewitz

Distributor: LRDC

Millikan's Oil Drop Experiment, 1992 **Physics 30**

Format Video (21 minutes)

Annotation *(Authorized Student Support)*

Millikan's oil drop experiment is described in terms of the following components:

- plotting voltages on drops
- falling drops give size of drop
- reasons for experimental error
- Millikan's scientific method
- accuracy of Millikan's work.

Price $65.75

Distributor LRDC 244666

Newton's First Law: Conceptual Physics with Hewitt Series, 1987 **Physics 20**

Format Video (27 minutes)

Annotation *(Authorized Student Support)*

Inservice training resource for teachers learning how to teach physics conceptually. Demonstrates the law of inertia. Laboratory demonstrations are performed by experts in the field of physics. Supplements Addison-Wesley's *Conceptual Physics: A High School Course.*

Price Contact distributor

Distributor ACCESS Network VC305201

Newton's Third Law: Conceptual Physics with Hewitt Series, 1987 **Physics 20**

Format Video (27 minutes)

Annotation *(Authorized Student Support)*

Explains the law of action and reaction. Aids and supplements class lectures and demonstrations and acts as an inservice training resource for teachers learning how to teach physics conceptually. Laboratory demonstrations are performed by experts in their field.

Price Contact distributor

Distributor ACCESS Network VC305301

One-Minute Readings: Issues in Science, Technology, and Society, 1992 **Physics 20–30**

Format: Print
Student Book ISBN 0201231573
Teacher Manual 020123159X

Annotation: (*Authorized Student Support* and *Authorized Teaching Resource*)

Contains readings and questions related to issues in science, technology and society. Applications of science are raising tough questions and are creating problems that cannot yet be answered. The book gives practice in making the kinds of decisions experienced in life. Students need a knowledge of science to find not necessarily the right answers, but the best possible answers.

Price: $10.70 Student Book
$8.50 Teacher Manual

Author: Richard F. Brinckerhoff

Distributor: LRDC — 105628 (student book), 105636 (teacher manual)

Perspectives in Science Series, 1989 **Physics 20–30**

Format: Videocassette
Videodisc

Annotation: (*Authorized Student Support*)

This series begins with a 30-minute introductory video, The Program in Action, and then three, one-hour interactive videos exploring the topics biotechnology, toxic waste and water. The series develops critical thinking about science, technology and society, examines basic applications, and points out unforeseen problems or complications often emerging as a consequence. Introductions contain docudramas with strong language and confrontation.

Price: $345 Videodisc

Distributor: National Film Board of Canada — Videocassette
Technovision Inc. — Videodisc

Physic-AL: An Activity Approach to Physics: Solution Manual, 1989 **Physics 20–30**

Format	Print	ISBN 0920008321
Annotation	(*Authorized Teaching Resource*)	
	Provides solutions to problems, questions and laboratory experiments covered in the student exercise books. The material covered correlates with concepts in the Physics 20–30 Program of Studies.	
Price	$30.95	
Author	Herbert Gottlieb, Brian Martin and Neil Spronk	
Distributor	LRDC	241109

Physic-AL: An Activity Approach to Physics: Student Exercise Book, Volumes 1 and 2, 1990 **Physics 20–30**

Format	Print	ISBN 0920008348
Annotation	(*Authorized Student Support*)	
	Two student exercise books, which include laboratory work and questions. Blank spaces and worksheets are provided throughout for recording data, computations and responses. Both volumes support the Physics 20–30 Program of Studies.	
Price	$9.75	
Author	Brian Martin and Cornelius Spronk	
Distributor	LRDC	241117

Physic-AL: An Activity Approach to Physics: Student Text, Revised Edition, 1991 **Physics 20–30**

Format	Print	ISBN 0920008305
Annotation	(*Authorized Student Support*)	
	An activity-oriented resource supporting the Physics 20–30 Program of Studies.	
Price	$58.30	
Author	Brian Martin and Cornelius Spronk	
Distributor	LRDC	241125

Physic-AL: An Activity Approach to Physics: Teacher Reference Manual, 1989 — **Physics 20–30**

Format	Print	ISBN 0920008283
Annotation	(*Authorized Teaching Resource*)	
	Outlines numerous activities correlating with concepts in the Physics 20–30 Program of Studies.	
Price	$19	
Author	Herbert Gottlieb, Brian Martin and Neil Spronk	
Distributor	LRDC	241092

Physics: Principles with Applications, Third Edition, 1991 — **Physics 20–30**

Format	Print	ISBN 0136725104
Annotation	(*Authorized Teaching Resource*)	
	Written at an introductory college level, this text uses algebra and elementary trigonometry, but not calculus. The applications of physics concepts include a wide range of examples from biology, medicine, architecture, technology, Earth sciences, the environment and daily life.	
Price	$65.50	
Author	Douglas C. Giancoli	
Distributor	LRDC	238792

Physics of Music: The Nature of Vibrations and Sound, 1992 — **Physics 20**

Format	Video (34 minutes)
Annotation	(*Authorized Student Support*)
	Explores the scientific principles of music. A wide range of instruments are examined, from the classical violin to the synthesizer, to illustrate the concepts and formulas of sound waves. The cathode ray oscilloscope is used extensively to demonstrate how complex musical notes are built up from simpler wave forms.
Price	Contact distributor
Distributor	ACCESS Network

Properties of Waves (Non-light), 1990 **Physics 20**

Format: Video (25 minutes)

Annotation: (*Authorized Student Support*)

The concepts covered in the video are:

- mechanisms of waves, such as ripples on the surface of liquids, and tension waves in strings
- characteristics of waves, such as amplitude, velocity and wavelength
- behaviour of waves, such as refraction, reflection, superposition, diffraction, interference, and velocity in different mediums.

Price: Contact distributor

Distributor: ACCESS Network

Science Process and Discovery **Physics 20–30**

Format: Print
Text, 1985 ISBN 0201186284
Teacher's Guide, 1989 0201186314

Annotation: (*Authorized Teaching Resource*)

- Examines significant events in the history of science and topics of current research through the use of short case studies.
- Written for the general-level science student, but allows deeper analysis of the scientific method for the more advanced student.
- Short narrative articles are followed by two different question sets.
- Analysis provokes thinking about the cycle of proof and scientific principles.
- Accompanying teacher's guide contains objective questions for each narrative.

Price: $17.65 Text
$23.65 Teacher's Guide

Author: Dennis Field

Distributor: LRDC 236374 (text)
238403 (teacher's guide)

Senior High Science Video Series, Programs 1–5, 1990 **Physics 20–30**

Format: Video

Annotation: (*Authorized Student Support*) BPN

Program 1: Baking Better Science 302201
Program 2: Zapped 302202
Program 3: Teaching from the STS Approach: The Nature of Science 302203
Program 4: Teaching from the STS Approach: Science and Technology 302204
Program 5: Teaching from the STS Approach: The Social Context of Science and Technology 302205

Programs 2 to 5 are teacher inservice video programs and are available on one tape.
Programs 3 to 5 show teachers practising science–technology–society strategies and interviewing educators and students about these methods. The teachers involved were practising the strategies in their classrooms in the fall of 1990—before implementation of most of the new programs, Science 14–24 being the exception.

Price: Contact distributor

Distributor: ACCESS Network

Superposition of Waves: Program 10: Senior High Science Series, 1992 **Physics 20**

Format: Video (13 minutes)

Annotation: (*Authorized Student Support*)

Wave forms can be used to describe the transmission of energy from one place to another. Transverse pulses and longitudinal wave forms are used to illustrate the phenomenon of superposition with laboratory demonstrations conducted by two teenage hosts and computer animated sequences.

Price: Contact distributor

Distributor: ACCESS Network BPN 302210

Thin Film Interference: Program 11: Senior High Science Series, 1992 **Physics 20**

Format: Video (10 minutes)

Annotation: (*Authorized Student Support*)

Light can be reflected in a number of ways depending on the type of media it encounters. Constructive and destructive interference of light due to thin film interference are studied through laboratory demonstrations conducted by two teenage hosts and computer animated sequences.

Price: Contact distributor

Distributor: ACCESS Network BPN 302211

Other Learning Resources: General

The resources identified below have not been evaluated by Alberta Education. These listings are not to be construed as an explicit or implicit departmental approval for use. They are provided as a service only to assist school authorities to identify resources that contain potentially useful ideas. The responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Note: Prices of resources are listed as provided by distributors, May 1993. Check with distributor for current rates.

Laboratory Interfaces

AC/DC Circuits: Physics Explorer Series, 1992 — **Physics 20**

Format	Courseware, Macintosh, 5 discs (3.5") and teacher's guide
Annotation	Simulates an electric circuit, enabling you to construct and analyze circuits. It may be used to study topics in currents and voltages, electromagnetic force, Ohm's law, and Kirchhoff's rule. Important information about the simulation can be constantly updated, such as its current and voltage outputs, or any other quantity that might be defined with an algebraic expression. This data can be displayed numerically or graphically, and may be saved to a spreadsheet for future analysis.
Price	$160 Canadian
Distributor	Wings for Learning/Sunburst Communications Inc.

Champ II — **Physics 20–30**

Format	MS–DOS and Macintosh
Annotation	Users perform/analyze experiments using probes, software and computer hardware.
Price	Contact distributor
Distributor	Merlan Scientific

Diffraction: Physics Explorer Series, 1992 **Physics 20**

Format: Courseware, Macintosh, 5 discs (3.5") and teacher's guide

Annotation: Simulates the diffraction–interference pattern produced by a coherent source(s) irradiating a regular, one-dimensional grating. During the simulation, the diffraction–interference pattern is displayed on a screen behind the grating, while a histogram of the scan pattern is displayed at the top of the model window. The off-screen sources are located roughly at the position of the viewer's eyes.

The model gives outputs during the simulation for source intensity, and for the position and angle of both the dynamic spectrum and a single photon. These data can be presented numerically or graphically during the simulation. They may also be saved to a spreadsheet for future analysis.

Price: $160 Canadian

Distributor: Wings for Learning/Sunburst Communications Inc.

Gravity: Physics Explorer Series, 1991 **Physics 20**

Format: Courseware, Macintosh, 5 discs (3.5") and teacher's guide

Annotation: Simulates the motion of a body (the object) in the gravitational field of a massive fixed body (the planet). It may be used to study topics in kinematics or dynamics, including Kepler's laws, possible paths in a gravitational field, escape velocity, central forces, and the conservation of energy and angular momentum.

What is needed to launch an artificial satellite and to place it in a particular orbit can be explored. Also to be explored is natural satellite behaviour: lunar orbits, the orbit of a planet around the Sun, or a model of the atom. There is a "less cosmic" perspective from the planet's surface; zoom in until the planet appears "flat", and carry out experiments in ballistics.

Important information about the simulation can be constantly updated, such as its angular momentum, kinetic energy, potential energy, or any other quantity that might be defined with an algebraic expression. This data can be displayed numerically or graphically, and may be saved to a spreadsheet for future analysis.

Price: $160 Canadian

Distributor: Wings for Learning/Sunburst Communications Inc.

Harmonic Motion, 1991 **Physics 20**

Format: Courseware, Macintosh, 5 discs (3.5") and teacher's guide

Annotation: Simulates the oscillation of a single mass about an equilibrium position at the centre of the screen. Many applications can be explored, such as the tonal quality of musical instruments, Lissajous figures, the characteristics of a pendulum, the interaction of light and matter, and the basics of radio reception, as well as the fundamental nature of waves.

The mass is acted upon by horizontal and vertical restoring forces that are proportional to the distances between the mass and the x and y axes respectively.

Output for the position of the object can be created, its speed and acceleration, as well as work done, kinetic energy, potential energy, or any other algebraic formula, by writing expressions that include input and output parameters; mass, instantaneous position, speed, etc. The data can be displayed numerically or graphically, and may be saved to a spreadsheet for future analysis.

Price: $160 Canadian

Distributor: Wings for Learning/Sunburst Communications Inc.

Leap **Physics 20–30**

Format: MS–DOS/Apple II/Macintosh

Annotation: Users perform/analyze experiments using probes, software and computer hardware. Interdisciplinary Lab Pac (physics/chemistry) and Biology and Principles of Technology Lab Pac (applied physics) are available. Laboratory pacs include manuals, interface card, software and several probes/cables.

Price: Contact distributor

Distributor: Quantum Technology Inc.

One Body: Physics Explorer Series, 1991 **Physics 20**

Format	Courseware, Macintosh, 5 discs (3.5") and teacher's guide
Annotation	Simulates a single body moving on the plane of the screen. The body moves at a constant velocity or an accelerated velocity, and the conditions under which the body moves can be changed. The model gives the following outputs during the simulation: body position (x, y), velocity (v_x, v_y), acceleration (a_x, a_y), and time (t). During the simulation output for the potential energy can be derived, the kinetic energy, or any other algebraic expression based on the above variables and the system input variables; mass, initial body position, initial velocity, etc. The data can be displayed numerically or graphically, and may be saved to a spreadsheet for future analysis. The model contains tools for measuring the distance between any two points and the angle between any two intersecting lines, three points.
Price	$160 Canadian
Distributor	Wings for Learning/Sunburst Communications Inc.

Personal Science Lab **Physics 20–30**

Format	MS–DOS
Annotation	Users perform/analyze experiments using probes, software and computer hardware.
Price	Contact distributor
Distributor	Contact local software outlet

Physics Explorer: Systems Guide, 1992 **Physics 20**

Format: Macintosh Versions 1.1, 1.2

Annotation: This simulation is designed to supplement hands-on laboratory work. It provides models for the qualitative and quantitative study of a wide range of natural phenomena in the physical and life sciences, including harmonic motion, ripple tanks, electrical circuits, electrostatics, waves, genetics and ecology.

The models and tools include: a variety of output displays, including line graphs, bar charts and pie charts; a built-in spreadsheet for recording and analyzing output data; and a scripting language for setting up custom-built software laboratories.

Price: Contact distributor

Distributor: Wings for Learning/Sunburst Communications Inc.

Ripple Tank, 1992 **Physics 20**

Format: Courseware, Macintosh, 5 discs (3.5") and teacher's guide

Annotation: Two-dimensional waves within defined tank walls are simulated. The waves are created by point or line sources that can generate a defined number of pulses or that pulse continuously. The source amplitude, frequency and phase can be set for two groups of source types, and every source is then assigned to one or the other set of type values.

Barriers can be inserted into the tank to study the effects of disturbances in the medium. In addition, the tank can be divided into different media with different characteristic constants.

The model includes three types of measurement tools: a ruler, for measuring distance; a protractor, for measuring angles; and a detector, for measuring amplitude. The measurements can be given as numeric displays or written to the spreadsheet.

Price: $160 Canadian

Distributor: Wings for Learning/Sunburst Communications Inc.

Two Bodies: Physics Explorer Series, 1991 **Physics 20**

Format: Courseware, Macintosh, 5 discs (3.5") and teacher's guide

Annotation: This model simulates two bodies moving in a single plane—the laboratory. The simulation can be viewed from any of five frames of reference; especially useful frames of reference are either of the two bodies or the centre of mass. Other available references are the fixed laboratory and the observer (a moving point).

The model gives outputs during the simulation for body position, velocity, the coordinates of the centre of mass, and time. The output for momentum, kinetic energy, or any other algebraic expression based on the above variables and the system input parameters can be derived. The data can be displayed numerically or graphically, and may be saved to a spreadsheet for future analysis.

Price: $160 Canadian

Distributor: Wings for Learning/Sunburst Communications Inc.

Waves, 1991 **Physics 20**

Format: Courseware, Macintosh, 5 discs (3.5") and teacher's guide

Annotation: This model simulates the motion of transverse waves on a string with up to fifty point masses that interact as if connected by springs. The user can explore the relationship between waves and oscillations, how wavelength and frequency relate to the speed of a wave, and how waves interfere with each other and interact with different media. This model can be applied to understanding the propagation of light and sound waves, light and optics, the creation of "rogue waves", the resonance of music in a room, and the internal mechanisms of lasers.

The location, velocity and acceleration of up to ten selected masses, as well as the kinetic energy and the potential energy for each of the three user-defined media, can be calculated. The data can be displayed numerically or graphically and may be saved to a spreadsheet for future analysis.

Price: $160 Canadian

Distributor: Wings for Learning/Sunburst Communications Inc.

Software

Interactive Physics **Physics 20–30**

Format: Macintosh

Annotation: Users create experiments by drawing objects on a screen. They adjust physical quantities, such as mass, friction, elasticity and gravity, to explore their effects on an experiment. Each set of exercises consists of a series of activities that involve modifying and observing experiments. The results of the experiments are then analyzed mathematically and conceptually.

Because real experiments are visually simulated, students learn by exploring and hypothesizing.

1. Stability
2. Free-fall in One Dimension
3. Relative Velocity and Acceleration
4. Newton's First Law
5. Newton's Laws: Mass and Acceleration
6. Mass and Weight
7. Uniform Circular Motion
8. Rotational Kinematics
9. Centre of Mass
10. Linear Momentum
11. Collisions on an Air Track
12. Two-dimensional Collision
13. Elastic Potential Energy and the Work Done by a Spring
14. Elastic Potential Energy, Gravitational Potential Energy and The Work Done by a Spring
15. The Spring-launched Ball
16. Power

Price: $249

Distributor: Contact local software distributor

LXR Test **Physics 20–30**

Format: Macintosh

Annotation: Test-generating program in three versions: personal, professional and scoring editions. The item banks on the Scoring Edition take full advantage of its additional features; however, they also work with the other two editions. For novices, there may be some "challenges" associated with using the Personal Edition.

Price: $599 U.S. (Site Licence) Personal
$799 U.S. (Site Licence) Professional
$999 U.S. (Site Licence) Scoring

Distributor: Logic eXtension Resources

Physics 20 Assessment Resources Package (Item Bank), 1992 **Physics 20**

Format: LXR test format and print

Annotation: Consists of four unit examinations and one year-end examination for Physics 20. Two formats are available:

- LXR test format (Macintosh) on five, 3½" discs
- print format, user's guide and accompanying graphics.

Also see *Science 20 Assessment Resources (ASCII Format)*, 1993.

Price: $11.15

Distributor: LRDC 237918

Science 20 Assessment Resources (ASCII Format), 1993 **Physics 20**

Format: MS–DOS (ASCII text format)
Macintosh (ASCII text format)

Annotation: MS–DOS includes four unit examinations and one final examination on a 3½" disc, as well as print material, user's guide and accompanying graphics for Biology 20, Chemistry 20, **Physics 20** and Science 20.

Macintosh includes four unit examinations and one final examination on five, 3½" discs, as well as print material, user's guide and accompanying graphics for Biology 20, Chemistry 20, **Physics 20** and Science 20.

Price: $21 each

Distributor: LRDC 237869 (MS–DOS)
237835 (Macintosh)

Videodiscs

Our Environment, 1990 **Physics 20**

Format: Videodisc

Annotation: Contained are 6000 environmental colour photos sequenced with explanatory captions, maps, diagrams and film segments. The disc includes:

- the four spheres of air, water, land and organisms
- a focus on important environmental problems, such as acid rain, energy usage, climate change, desertification, wetlands loss, tropical deforestation, oil spills, nuclear power and weapons, soil erosion, solid waste, species extinction, asbestos and water pollution
- a visual glossary illustrating over 700 environmental terms and surveying the globe with captioned photos.

Price: $395 U.S. Videodisc
$30 U.S. Teacher Manual
$15 U.S. Student Manual
$70 U.S. HyperCard Stacks

Distributor: Optilearn

Physics and Automobile Collisions, 1984 **Physics 20**

Format: Videodisc

Annotation: Using footage of car collisions, this disc provides a graphic way to study the principles of momentum, Newton's laws, and mechanical energy. Collisions are recorded on the disc, while an audio track emphasizes key concepts during the motion. The action can then be analyzed, using freeze-frame control, to measure the screen and gather data. Appropriate for three levels of physics instruction: descriptive physics, the algebra/trigonometry course in college physics, and calculus-based engineering physics.

Price: $360

Distributor: Videodiscovery Inc.

Physics of Sports, 1988 **Physics 20**

Format: Videodisc

Annotation: This record of over twenty athletic events, filmed for scientific analysis, provides visual data from which quantitative data can be collected by biomechanics, kinesiology and physics students. The videodisc is used to step through actions in 1/30 second intervals. Using a sheet of clear acetate over the image on the monitor, students can study each position and collect data on such physical principles as linear motion, projectiles, energy transformation, momentum, impulse and time. This is one way of applying physics to real-world problems. Included is a student handbook and a teacher's guide with a directory of the images, formulas and step by step instructions.

Price: $366

Distributor: Videodiscovery Inc.

Physics at Work, 1992 **Physics 20–30**

Format: Videodisc ISBN 1563070863

Annotation: *Physics at Work* includes a double-sided CAV videodisc, bar-coded image directory, and quick reference card. The directory contains suggested activities and English and Spanish narration of the audio tracks. Optional Macintosh and MS–DOS computer software and lessons are available.

1. Directory
2. Static Equilibrium
3. Vectors
4. Uniform Accelerated Linear Motion
5. Newton's Laws
6. Work and Energy
7. Linear Momentum
8. Circular Motion
9. Rotational Work
10. Mechanical Properties of Matter
11. Gases
12. Thermal Properties
13. Thermodynamics
14. Vibration and Waves
15. Sound
16. Electric Forces and Fields
17. Electric Potential
18. DC Circuits
19. Magnetism
20. Electromagnetic Induction
21. Alternating Currents
22. Electromagnetic Waves
23. Properties of Light
24. Optical Devices
25. Interference and Diffraction
26. Three Revolutionary Concepts
27. Energy Levels and Spectra
28. Atomic Nucleus
29. Physics of "Large and Small"
30. Astronomy
31. Motion Movies
32. Matter
33. Astronomy Movies
34. Waves and Cyclic Motion Movies
35. Electricity and Magnetism Movies
36. Sound Movies
37. Machines and Technology Movies
38. Light and Optics Movies
39. Environment Movies

Price: $549 Package Price
$150 Software Price

Distributor: Videodiscovery Inc.

Video Encyclopedia of Physics Demonstrations (The), 1992 **Physics 20–30**

Format	Laserdisc
Annotation	A series of videotaped physics demonstrations is augmented by slow motion photography and animation, with an interactive format allowing participation in questions and calculations done "off the screen". Topics covered are: • Electricity and Magnetism • Fluid Dynamics • Heat and Thermodynamics • Mechanics • Modern Physics • Optics • Sound • Waves
Price	$2995 U.S. 25 laserdiscs and print directories (set only—not sold individually)
Distributor	The Education Group

Teacher Background

Addison-Wesley Conceptual Physics: A High School Physics Program, 1988 **Physics 20–30**

Format	Print	ISBN 0201224585
Annotation	A comprehensive test bank for topics in the current Physics 20–30 program.	
Price	Contact distributor	
Author	Joyce Chang et al.	
Distributor	Addison-Wesley Publishers Limited	

Clouds in a Glass of Beer: Simple Experiments in Atmospheric Physics, 1987 **Physics 20**

Format	Print	ISBN 0471624829
Annotation	Contains experiments for diffusion, heat transfer, conservation of energy, kinetic potential, solar radiation, the freezing point of water and cloud formations.	
Price	$23.95	
Author	Craig F. Bohren	
Distributor	John Wiley & Sons Canada Ltd.	

Cold Fusion, 1990 **Physics 20**

Format	Print	ISBN 0809240858
Annotation	Physicist F. David Peat explains Stanley Pons and Martin Fleishmann's experiment producing controlled nuclear fusion at room temperature in a test tube, as well as how cold fusion may yet prove to be the solution to many of the world's energy problems.	
Price	$11	
Author	F. David Peat	
Distributor	Fitzhenry and Whiteside Ltd.	

Complete Handbook of Science Fair Projects (The), 1991 **Physics 20**

Format	Print	ISBN	0471527297(c) 0471527289(p)
Annotation	Contains 50 award-winning projects from actual science fairs, described in detail with accompanying illustrations and 500 other suggested science fair topics suitable for junior and senior high science students. Detailed guidelines for preparing a science fair project are outlined. This includes selection of topic, obtaining materials, recording data and suggestions for oral presentation.		
Price	$18.50		
Author	Julianne Blair Bochinski		
Distributor	John Wiley & Sons Canada Ltd.		

Conceptual Physics, Sixth Edition, 1989 **Physics 20**

Format	Print	ISBN	0673398471
Annotation	Physics is treated conceptually, rather than mathematically, in this text. The concepts are presented and equations are used as guides for thinking, rather than recipes for algebraic problem solving.		
Price	$46.69 U.S.		
Author	Paul G. Hewitt		
Distributor	Scott, Foresman and Co.		

Contemporary College Physics, 1990 **Physics 20–30**

Format	Print	ISBN	020111951X
	Student's Solution Manual		0201129957
	Instructor's Manual		0201129949
	Test Item File		0201508192
	Transparencies		0201518805
	Study Guide		0201129973
Annotation	Covers the major topics in Physics 20–30 in a comprehensive but not encyclopaedic manner.		
Price	Contact distributor		
Author	Edwin R. Jones and Richard L. Childers		
Distributor	Addison-Wesley Publishers Limited		

Einstein's Moon: Bell's Theorem and the Curious Quest for Quantum Reality, 1990 **Physics 30**

Format	Print	ISBN 0809239655
Annotation	The development of the quantum theory is one of the greatest scientific achievements of the twentieth century. This is the story of the development of the quantum theory and of the philosophical problems it poses.	
Price	$15	
Author	F. David Peat	
Distributor	Fitzhenry and Whiteside Ltd.	

Energy Alternatives: Transparency Masters and Discussion Notes **Physics 20–30**

Format	Print
Annotation	The materials in this resource focus on making the best choices to meet Canada's future energy needs. Forms of energy alternatives are examined, as well as the advantages and disadvantages of each energy source. Decisions to determine which energy sources should be pursued, and where facilities should be located, are very complex in nature. Each of eight sections contains information about current technologies and national and international energy resources research activity. Transparency masters can be used to initiate discussion.
Price	Free
Distributor	P. J. Spratt & Associates Inc.

Focus on Research: A Guide to Developing Students' Research Skills, 1990 **Physics 20–30**

Format	Print	
Annotation	Outlined is a resource-based research model to help manage information efficiently and effectively, and gain transferable skills to all work situations. The model provides a developmental approach to doing research.	
Price	$4.10	
Author	Alberta Education	
Distributor	LRDC	161802

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Fundamentals of Physics: A Senior Course, 1986 **Physics 20**

Format	Print ISBN 0669950475
Annotation	This text is written for a senior-level high school physics course and provides a thorough examination of basic physical concepts. It is algebra-based with many examples drawn from everyday life.
Price	Contact distributor
Author	David G. Martindale, Robert W. Heath and Philip C. Eastman
Distributor	D. C. Heath Canada Ltd.

Fusion: Energy for the Future, 1991 **Physics 30**

Format	Print
Annotation	This booklet examines what fusion is, the impact of fusion power, international fusion research, and Canada's technologies and fusion programs.
Price	Free
Distributor	P. J. Spratt & Associates Inc.

Health and Safety on the Job: Audio-visual Catalogue, 1992 **Physics 20–30**

Format	Print (catalogue)
Annotation	Lists several audio-visual resources available from Alberta Labour Library.
Price	Free
Distributor	Alberta Labour Library

History of Physics (The), 1985 **Physics 20–30**

Format: Print ISBN 0802707513

Annotation: This text is divided into three parts. The first, "Motion, Sound and Heat", considers physics from an essentially Newtonian viewpoint. Beginning with the study of motion and the work of Galileo, it progresses to Newton's synthesis of the laws of motion and the laws of universal gravitation to the conservation laws of momentum, angular momentum and energy, and the laws of sound and heat. The second, "Light, Magnetism and Electricity", considers physics from the viewpoint of the late nineteenth century and early twentieth century. Asimov explores the properties of light and colour, of magnetic fields and electric currents, and finally, Einstein's theory of relativity and Planck's quantum theory, which helped initiate the second scientific revolution in the first decades of the twentieth century. The third part, "The Electron, Proton and Neutron", considers the physics of modern times—the study of the world of the infinitesimally small. Asimov tells of the discovery of the structure of the atom, of radioactivity, nuclear fission and fusion, and of the inner workings of the atom's nucleus. Finally, an appendix covers the latest frontier in physics—the family of fleeting elementary particles (muons, quarks, leptons and their siblings)—and how everything may be tied together by grand unified theories.

Price: $40.43

Author: Isaac Asimov

Distributor: Thomas Allen and Sons

How Safe Is Enough? 1983 **Physics 20–30**

Format: Video (18 minutes)

Annotation: This program is an introduction to risk-benefit analysis. The following concepts are discussed by a group of three students and an instructor:

- most human activities involve some risk
- a number of activities are ranked according to the number of deaths they cause in Canada
- risk perceptions vary from person to person. Inaccurate evaluations are dependent on preconceptions due to personal experience
- risk analysis involves estimating the consequences of risks and the probability of their occurrence, a mathematical equation is derived
- risk analysis assists in the decision-making process of individuals.

The video is accompanied by a teacher's guide entitled *On the Perception, Estimation and Evaluation of Risk.*

Price: Contact distributor

Distributor: P. J. Spratt & Associates Inc. 73

Instructor's Resource Manual for Physics: A World View: Saunders Golden Sunburst Series, 1992 **Physics 20**

Format	Print	ISBN 0030751314
Annotation	This manual has samples of problems and summaries of concepts.	
Price	$40.95	
Author	Larry D. Kirkpatrick and Gerald F. Wheeler	
Distributor	Harcourt Brace and Company Canada	

Levitating Trains and Kamikaze Genes: Technological Literacy for the 1990s, 1991 **Physics 20**

Format	Print	ISBN 0060973692
Annotation	This is a guide to technological literacy with a list of topics on space technology, biotechnology, computer literacy, energy, superconductivity, high technology, health and transportation.	
Price	$11.95	
Author	Richard P. Brennan	
Distributor	Harper Collins Books of Canada Ltd.	

Matter and Energy, 1987 **Physics 20–30**

Format	Print	ISBN 0772515581
Annotation	This text demonstrates the processes for finding quantitative relations from experimental data.	
Price	Contact distributor	
Author	Peter T. Spencer, Kenneth G. McNeill and James H. MacLachlan	
Distributor	Irwin Publishing Inc.	

Meeting Future Energy Needs: Teachers' Guide **Physics 20–30**

Format	Print
Annotation	Describes a game simulating the use of energy resources. Players assume different roles: an energy review board, option/interest groups and interveners. They then examine a range of options to determine the best uses for future energy resources.
Price	Free
Distributor	P. J. Spratt & Associates Inc.

Overhead Transparencies in Full Color to Accompany Physics: A World View, 1992 **Physics 20**

Format	Print ISBN 0030751330
Annotation	The transparencies supplement the content of the text.
Price	$253.95
Author	Larry D. Kirkpatrick and Gerald F. Wheeler
Distributor	Harcourt Brace and Company Canada

Physics, 1990 **Physics 20–30**

Format	Print ISBN 0333465156
Annotation	This book concentrates on principles and applications of physics in real-world events and situations. It provides extensive exercises and assignments.
Price	$39.45
Author	Robert Hutchings
Distributor	Nelson Canada

Physics, Second Edition, 1992 **Physics 20–30**

Format	Print	ISBN 0471529192
Annotation	Algebraic-based physics text; flexible organization; integrated concepts approach; highly visual, four-colour chapter summaries; numerous applications to biology, technology, etc.; numerous examples and problems to facilitate learning.	
Price	$69.95	
Author	John D. Cutnell and Kenneth W. Johnson	
Distributor	John Wiley & Sons Canada Ltd.	

Physics: Nuffield Coordinated Sciences and Teacher's Guide, 1992 **Physics 20–30**

Format	Print	
	Text	ISBN 0582093961
	Teacher's Guide	0582093937
Annotation	This book illustrates how physics is applied in the home, in industry, careers and so on. An integration of physics, biology and chemistry is outlined. The teacher's guide outlines objectives and includes detailed guidance about the teaching of biology, chemistry, physics, Earth sciences and astronomy.	
Price	Contact distributor	
Distributor	Copp Clark Pitman Ltd.	

Physics: A Numerical World View to Accompany Physics: A World View: Saunders Golden Sunburst Series, 1992 **Physics 20**

Format	Print	ISBN 0030764033
Annotation	Develops some of the numerical aspects of the study of physics that can be accessed with algebra and geometry.	
Price	$18.95	
Author	Larry D. Kirkpatrick and Gerald F. Wheeler	
Distributor	Harcourt Brace and Company Canada	

Physics: A Practical Approach, 1981 **Physics 20**

Format	Print	ISBN 047179967X
	Teacher's Manual	047179936X
Annotation	Covers the concepts of light, atomic physics, radioactivity, motion and waves.	
Price	Contact distributor	
Author	Alan J. Hirsch	
Distributor	John Wiley & Sons Canada Ltd.	

Physics: A Practical and Conceptual Approach, Second Edition, 1989 **Physics 20**

Format	Print	ISBN 0030237645
	Home Study Experiments	0030293782
Annotation	The text covers the major topics in Physics 20 in a comprehensive and interesting manner.	
Price	Contact distributor	
Author	Jerry D. Wilson	
Distributor	Harcourt Brace and Company Canada	

Physics: A World View, 1992 **Physics 20–30**

Format	Print	ISBN 0030353521
Annotation	The book features illustrations of physics concepts. Each section gives an overview of the subject and some historical perspectives and background. Mathematics is kept to a minimum. Questions to stimulate thinking and test comprehension are included. Short biographies of scientists are presented.	
Price	$59.95	
Author	Larry D. Kirkpatrick and Gerald F. Wheeler	
Distributor	Harcourt Brace and Company Canada	

Physics Around You (The), 1988 **Physics 20–30**

Format	Print	ISBN 0534086705
	Instructor's Manual	0534086713
Annotation	An introduction to physics for the nonscientist. By focusing on the physics encountered every day, readers are encouraged to wonder about the physical causes for everything that goes on around them and to look for an explanation in the principles of physics.	
Price	Contact distributor	
Author	Dale D. Long	
Distributor	Nelson Canada	

Physics Fundamentals and Frontiers, 1980 **Physics 20–30**

Format	Print	
	Text	ISBN 0395266491
	Teacher's Guide	0395266505
	Duplicating Masters for Progress Tests	0395254289
	Laboratory Supplement	0395254288
Annotation	This book investigates some of the major topics covered in each of the units in the Physics 20–30 Program of Studies, and addresses the interrelationships of science, technology and society.	
Price	Contact distributor	
Author	Robert Stollberg and Faith Fitch Hill	
Distributor	Nelson Canada	

Power and the Promise (The), 1993 **Physics 20–30**

Format	Print	ISBN 0969715404
Annotation	This resource includes the medical research and personal profiles of some of Alberta's scientists, who are on the leading edge of research in the genetics of cancer, infectious diseases, nerve regeneration and other areas. It reports on current medical research in the province, combined with information on patient and population health research.	
Price:	Free	
Distributor	Alberta Heritage Foundation for Medical Research	

Reviewing Physics with Sample Examinations, 1991 **Physics 20**

Format	Print	ISBN 0877201722
Annotation	This book is a source of science, technology and society questions in physics that can be used for class tests and discussions.	
Price	Contact publisher	
Author	David R. Kiefer and Judah Landa	
Distributor	AMSCO School Publications	

Science Matters: Achieving Scientific Literacy, 1991 **Physics 20**

Format	Print	ISBN 038526108X
Annotation	This book provides information toward becoming scientifically literate. It contains chapters on:	

- Scientific Literacy
- Knowing Energy
- Electricity and Magnetism
- The Atom
- The World of the Quantum
- Chemical Bonding
- Atomic Architecture
- Nuclear Physics
- Particle Physics
- Astronomy
- The Cosmos
- Relativity
- The Restless Earth
- Earth Cycles
- The Ladder of Life
- The Code of Life
- Evolution
- Ecosystems.

Price	Contact distributor
Author	Robert M. Hazen and James Trefil
Distributor	Doubleday Canada Ltd.

SEEDS: Energy Literacy Series, 1983 **Physics 20**

Format: Print

Annotation: Useful as a reference for energy activities, this series consists of several components:

- Renewable Sources of Energy
- Energy Technologies
- Energy in the Future
- Energy Systems
- Sources of Electrical Energy
- Nonrenewable Sources of Energy

Copies of these materials were distributed to every high school in Alberta.

Price: $10 Teacher's Guide (student books no longer available, but copyright permission is released with purchase of the teacher's guide).

Distributor: SEEDS Foundation

Senior High Science Inservice Modules, 1991 **Physics 20–30**

Format: Print

Annotation: A system-based development model for workshops, a planning manual, containing the following thirteen modules:

Module 1 – Teaching for Thinking
Module 2 – STS Teaching Strategies
Module 3 – Controversial Issues in the Classroom
Module 4 – Focus on Research
Module 5 – Science 10: A Hands-on Sampler
Module 6 – Performance Assessment in Science 10
Module 7 – Technology and Media in the Science Classroom
Module 8 – Cooperative Learning
Module 9 – Teaching for Conceptual Change
Module 10 – Teaching with Gender Balance
Module 11 – Questioning Techniques for Science Teachers
Module 12 – Environmental Connections in the New Science Programs
Module 13 – Agricultural Connections in the New Science Programs

Price: $25 (not available individually)

Author: Alberta Education

Distributor: LRDC 144684

State of Canada's Environment (The), 1991 **Physics 20–30**

Format	Print	ISBN 0660142376
Annotation	This report covers environmental concerns and what Canadians are doing to address them. What are the key environmental conditions and trends in Canada? What are the links between human activities and environmental changes? What are the ecological and health dangers?	
Price	$29.95	
Author	Environment Canada	
Distributor	Environment Canada	

STS Science Education: Unifying the Goals of Science, 1990 **Physics 20–30**

Format	Print	
Annotation	This publication provides a comprehensive description to help integrate science–technology–society concepts into teaching strategies.	
Price	$3.25	
Author	F. Jenkins	
Distributor	LRDC	162769

Teaching Thinking: Enhancing Learning, 1990 **Physics 20–30**

Format	Print	ISBN 1550062271
Annotation	Principles and guidelines for cultivating thinking, from Early Childhood Services to Grade 12, have been developed in this resource. It offers a definition of thinking, describes nine basic principles upon which the suggested practices are based, and discusses possible procedures for implementation in schools and classrooms.	
Price	$4.20	
Author	Alberta Education	
Distributor	LRDC	161521

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Together We Learn (Co-operative Small Group Learning), 1990 **Physics 20–30**

Format: Print/Video

Annotation: This "how-to" handbook is designed to help implement small group learning strategies in the classroom. It offers the following:

- a nuts and bolts approach to cooperative learning that provides classroom suggestions and aids
- thorough coverage of cooperative learning approaches to assist teachers of varying levels of experience with group work
- suggestions that are relevant to all grades, disciplines and students
- a jargon-free, easy to read, treatment of cooperative learning techniques.

Price: Contact distributor

Author: R. Wideman et al.

Distributor: LRDC Print 148959
ACCESS Network Video

Triumph of Discovery (The): Women Scientists Who Won the Nobel Prize, 1991 **Physics 20–30**

Format: Print
Hardcover ISBN 0671693328
Softcover 0671693336

Annotation: The Nobel Prize laureate is one of the most sought after of international honours. Nearly 500 Nobel prizes have been awarded to scientists, ten of whom were women. This book tells the story of four of these female scientists from their early struggles to their breakthrough discoveries.

Maria Goeppert – fought prejudice toward women in science to study physics in her native Germany. Her work helped lead to the development of the atomic bomb and experimentation with shell models.

Rosalyn Yalow – a scientist, wife and mother, whose study of nuclear physics led her to discover ways of "tagging" substances in blood with radioactive tracers.

Barbara McClintock – overcame the opposition of her family to attend college and devote her life to the study of maize genetics.

Rita Levi-Montalcini – survived anti-Semitism in facist Italy to train as a doctor and biologist investigating nerve growth.

Price: $13.98 U.S. Hardcover
$8.95 U.S. Softcover

Author: Joan Dash

Distributor: Julian Messner

World of Physics (The): Volume III: The Evolutionary Cosmos and the Limits of Science, 1987 **Physics 20–30**

Format	Print	ISBN 0671499319
Annotation	This volume concentrates on the developments in physics in the twentieth century and the application of the principles of relativity and quantum theory to such phenomena as stars, black holes and the evolution of the Universe.	
Price	$29.95	
Author	Jefferson Hane Weaver	
Distributor	Simon and Schuster	

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Other Learning Resources: Physics 20

The resources identified below have not been evaluated by Alberta Education. These listings are not to be construed as an explicit or implicit departmental approval for use. They are provided as a service only to assist school authorities to identify resources that contain potentially useful ideas. The responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Note: Prices of resources are listed as provided by distributors, May 1993. Check with distributors for current rates.

Unit 1: Kinematics and Dynamics

Exploration Science Snackbook (The), 1991

Format: Print ISBN 0943451256

Annotation: This is a resource for science teachers, written by science teachers who participated in the programs of the Exploratorium Teacher Institute in San Francisco. Each activity describes how to build a classroom version of a particular Exploratorium exhibit. The activities include instructions and helpful hints accompanied by photographs and line drawings. The simple materials used in the experiments/activities can be obtained from hardware, toy, home and school supply stores. Complex concepts can be made easy to understand by initiating class discussion using the simple demonstrations described.

Price: $24.95 U.S.

Author: Exploratorium Teacher Institute

Distributor: Exploratorium

Force and Motion: Newton's Three Laws, 1982

Format: Video (17 minutes)

Annotation: With experiments and laboratory demonstrations, this basic physics video explains Newton's three fundamental laws of force and motion. The velocity of an object remains constant unless a force acts upon it. Force is equal to the mass multiplied by acceleration. To every action there is an equal and opposite reaction. Newton's laws provide the means by which to predict how any object will behave when a force is exerted upon it. By better understanding these, and other laws of nature, a more thorough knowledge can be gained of the physical events taking place in the real world.

Price: Contact distributor

Distributor: Visual Education Centre

Inertia: The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	Copernicus conjectured that the Earth spins on its axis and orbits around the Sun. This assumption prompted many questions: Why do objects fall to Earth rather than hurtle off into space? And in this scheme of things, in which the Earth was not at the centre; Where was God? Galileo helped to answer such questions with the law of inertia.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Law of Falling Bodies (The): The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	With the conventional wisdom of the Aristotelian world view, almost everyone could see that heavy bodies fell faster than lighter ones. However, Galileo deduced that the distance a body has fallen at any instant is proportional to the square of the time spent falling. His experiments proved that all bodies fall with the same constant acceleration.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Laws of Motion Applied (The): Physics in Action Series, 1991

Format	Video (20 minutes)
Annotation	This program studies the laws of motion through collisions and the conservation of momentum, showing the difference between elastic and inelastic collisions, and using a laboratory air track to determine the muzzle velocity of a rifle bullet. An application of Newton's laws, using a rocket, illustrates the conservation of momentum; and a modern laboratory substitute for Galileo's experiment, explains why a feather and a metal washer, dropped simultaneously from the same height in a vacuum, reach the ground at the same time. The program demonstrates how the complex technology of space flight depends on the applications of the laws of motion.
Price	$149 U.S.
Distributor	Films for the Humanities and Sciences

Newton's Laws: The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	This program covers Newton's three laws of motion. A refinement on Galileo's law of inertia, Newton's first law states that all bodies remain at rest or continue in uniform motion unless an unbalanced force acts on them. His second law relates the causes of motion to the changes of motion in every object in the cosmos. Newton's third law explains the phenomenon of interactions; for every action, there is an equal and opposite reaction. The program includes examples of how Newton's laws are applied in real life.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Quad 1: Physics in Earth and in the Heavens: The Mechanical Universe Series, 1989 [also for Physics 20, Unit 2]

Format	Video (60 minutes)
Annotation	**Newton's Laws** What are the causes of motion? Galileo's laws of falling bodies and inertia describe how objects move. However, they do not explain why. In this video, Newton's work of completing Galileo's kinematics with dynamics—a theory of the causes of motion—is described. Not only did Newton's three laws introduce a new order to scientific thought, they opened up questions about force and mass. **The Apple and the Moon** How is the motion of the moon around the Earth like that of a falling apple? Newton's answer to the question came to be known as his law of universal gravitation. Galileo had described the law of falling bodies—gravity on Earth—and Kepler had described planetary orbits—gravity in space. In this program, how the universal law of gravitation emerged from Newton's efforts to reconcile Galileo's new kinematics with Kepler's new astronomy is explained. Together with Newton's three laws of motion, the law of universal gravitation provides the basis for Newton's view of how the Universe works. **Harmonic Motion** [also for Physics 20, Unit 3] Why do some motions repeat themselves regularly? An application of Newton's second law in explaining physics on the Earth is simple harmonic motion. In this video, simple harmonic motion is presented as a model illustrating the scientific process of determining simple, underlying physical principles from complex behaviour. **Navigating in Space** How do you get from Earth to Venus? Interplanetary travel is introduced as an application of the celestial mechanics of Kepler and Newton. In this program, important principles of classical mechanics are reviewed through application. The ideas behind transfer orbits, launch opportunities, launch windows, and gravity are explained.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Quad 3: Kinematics and Scientific Methods: The Mechanical Universe Series, 1989

Format: Video (45 minutes)

Annotation:

The Law of Falling Bodies
Do heavier bodies fall faster than lighter ones? The way that Galileo arrived at an answer to this question was as revolutionary as the answer itself. Although Galileo could not create a vacuum, he could imagine one, and so he realized that in a vacuum all bodies fall with the same constant acceleration. This program shows Galileo's investigation of the law of falling bodies with an emphasis on scientific methods.

The Law of Inertia
How can the motion of a falling object appear the same on a moving Earth as on a stationary Earth? In defending the Copernican system, Galileo discovered that the description of the motion of objects on Earth demanded an understanding of inertia quite different from the prevailing Aristotelian conception. He realized that the tendency of an object was not, as Aristotle thought, to reach a state of rest, but rather to continue moving without any propelling force. In this program, the methods Galileo used to arrive at the law of inertia and its immediate consequence, the relativity of motion, are examined.

Moving in Circles
Plato explained motion in a circle with constant speed. In this program, the kinematics of circular motion is explored; the relationships among radius, velocity and acceleration are developed. When Newton's universal law of gravitation is incorporated as the driving force, the circular motion of planets is revealed.

Price: $99

Distributor: Magic Lantern Communications Ltd.

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Survival of Physics: Problem Solving in Newtonian Mechanics, 1991 [also for Physics 20, Unit 2 and Unit 3]

Format	Print	ISBN 1895113024
Annotation	This text takes an "apprentice" approach through 105 problems and solutions, emphasizing them conceptually, and showing how to organize written solutions. Various techniques are used to encourage visualizing physics problems to get out of the habit of simply substituting numbers into equations. The assumptions of Newtonian physics are stated clearly, so that the material is contextualized, establishing a conceptual foundation and encouraging reflection on how physics relates to other aspects of education. An annotated reading list is also included.	
Price	$23.35 per copy (discounts for large orders)	
Author	Jeff Culbert	
Distributor	Puretone Publishing Co. Ltd.	

Turning the World Inside Out, 1990 [also for Physics 30, Unit 1]

Format	Print	ISBN 0691023956
Annotation	A collection of physics demonstrations costing very little to produce yet illustrating key concepts in simple ways. Each demonstration outlines the objective, the equipment needed and the procedure, including ways to perform demonstrations on an overhead projector. Concrete examples are accompanied by theoretical background for a basic understanding of physical principles. Demonstrations containing a quantitative component work well as mini-experiments and as a means of illustrating the results of calculations.	
Price	$19.95 U.S.	
Author	Robert Ehrlich	
Distributor	Princeton University Press	

Vectors, 1990

Format	Video (19 minutes)
Annotation	Force has direction and magnitude. Addition of forces can be drawn as a diagram. Anything with both direction and magnitude is a vector; e.g., force. The resultant is that of adding several vectors together. Vectors can be added in any order; e.g., canoe doing a ferry glide in a river. Vectors can be resolved into vertical and horizontal components. The program explains how vectors are added, and why vectors can be added tip to tail. Vector diagrams for some real-world situations are shown; e.g., people leaning back to back, rock climbers climbing, flying fox, 3-way tug-of-war.
Price	$69
Distributor	Classroom Video

Vectors: The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	Physicists and mathematicians invented a way of describing quantities that have direction as well as magnitude. Laws that deal with such phenomena as distance and speed are universal. And vectors, which describe quantities such as displacement and velocity, universally express the laws of physics in a way that is the same for all coordinate systems. The program includes examples of how vectors are used in real life.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Unit 2: Circular Motion and Gravitation

Going Around in Circles, 1991

Format	Video (20 minutes)
Annotation	This is a program about gravity, a force that acts without contact. A theme park acts as a backdrop to the examination of the force of gravity. Circular motion is seen as the result of forces known as centripetal force.
Price	$320
Distributor	T. H. A. Media Distributors

Kepler Problem (The): The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	The task of deducing all three of Kepler's laws from Newton's universal law of gravitation is known as the Kepler problem. Its solution is one of great achievement in the world of mathematics and science.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Kepler's Three Laws: The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	Kepler's three laws describing the motion of bodies in space is explained.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Microgravity: Space Education Series, 1989

Format	Video (12:25 minutes)
Annotation	Gravity and its varying effects are explored, and a spacecraft in orbit is compared with a thrown ball to explain the concept of free fall. Zero gravity is introduced, and some experiments performed in a National Aeronautics and Space Administration's KC-13 jet flown at zero gravity are shown.
Price	Contact distributor
Distributor	TV Ontario

Moving in Circles: The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	According to Plato, stars are heavenly beings that orbit the Earth with uniform perfection, uniform speed and in perfect circles. The concept of circular motion is compared to this original Platonic ideal.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Quad 1: Physics in Earth and in the Heavens: The Mechanical Universe Series, 1989

[see annotation Physics 20, Unit 1]

Survival of Physics: Problem Solving in Newtonian Mechanics, 1991

[see annotation Physics 20, Unit 1]

Unit 3: Mechanical Waves

Energy Control and Communication: Pathways Through Science Series, 1992

Format	Print ISBN 0582094119
Annotation	This module contains strategies and activities dealing with sound vibrations, sound signals and electronic control. Examples of some of the investigations are how sound travels, magnetic field investigations, building a door alarm and synthesizers. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to sound and electron control systems. A study guide outlines main ideas for review. Some of the examples used have a British context.
Price	$69.56
Distributor	Copp Clark Pitman Ltd.

Harmonic Motion, 1984

Format	Video (21 minutes)
Annotation	Harmonic motion is a mechanical phenomenon. It refers to motion that repeats itself over equal time intervals. Any bit of matter, even an atom, oscillating with uniform frequency is demonstrating harmonic motion. Time recorded by the oscillations of the quartz crystal in an electronic watch or the resonance of a vibrating piano string, are but two examples of the diverse phenomenon provided by harmonic motion. Using laboratory experiments and real-life examples, this film explores harmonic motion.
Price	Contact distributor
Distributor	Visual Education Centre

Quad 1: Harmonic Motion: Physics in Earth and in the Heavens: The Mechanical Universe Series, 1989 [see annotation Physics 20, Unit 1]

Resonance: The Mechanical Universe Series, 1985

Format	Video (28 minutes)
Annotation	As Galileo noted, the swings of a pendulum increasingly grow with repeated, timed applications of a small force. When the frequency of an applied force matches the natural frequency of a system, large-amplitude oscillation results in the phenomenon of resonance. Resonance explains why a swaying bridge collapses in a high wind, and why a wineglass shatters at a high octave.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Sound, Energy and Wave Motion: Physical Science Series, 1986

Format — Video (14 minutes)

Annotation — A jazz trio playing musical instruments in an open field give a demonstration of how sound energy moves from player to instrument to the surrounding air; and then how it is transferred by compressional waves to produce energy changes in the listener's ears. An examination of musical instruments illustrates the relationship among the pitch, frequency, loudness and amplitude of sound waves and explains how and why sounds of the same pitch and loudness can differ in quality to give instruments their characteristic sounds.

Price — $99

Distributor — Coronet Film and Video

Sound, Music and Noise: Science in Focus Series, 1991

Format — Video (20 minutes)

Annotation — What is sound? This program looks at the sounds we want to hear—music; the sounds we don't—noise; and the aspects music and noise have in common. The effect of sound is seen as patterns on soap film and as measured wave patterns. Wave properties, such as frequency, wavelength and velocity, are demonstrated with high-speed photography. Also examined are microphones and how they work, as well as the acoustic properties of different environments.

Price — $320

Distributor — T. H. A. Media Distributors

Survival of Physics: Problem Solving in Newtonian Mechanics, 1991

[see annotation Physics 20, Unit 1]

Waves: The Mechanical Universe Series, 1985

Format — Video (28 minutes)

Annotation — This program analyzes simple harmonic motion in terms of Newton's extension of the mechanics of sound propagation.

Price — $99

Distributor — Magic Lantern Communications Ltd.

Waves and Sound, 1987

Format	Video (30 minutes)
Annotation	Provides demonstrations of wave motion, resonance and sound. Aids and supplements in-class lectures and demonstrations, and acts as an inservice training resource for teachers learning how to teach physics conceptually.
Price	Contact distributor
Distributor	ACCESS Network

Unit 4: Light

Behaviour of Light (The), 1983

Format	Video (20 minutes)
Annotation	This program traces the history of thought on light and examines, through experiments, the natural properties of light.
Price	Contact distributor
Distributor	Visual Education Centre

Convex and Concave Lenses: Introductory Concepts in Physics Series, 1987

Format	Video (10 minutes)
Annotation	Experiments show the differences in function between a convex and a concave lens, and the differences in image produced by the arrangement and combination of lenses.
Price	$69.95 U.S.
Distributor	Films for the Humanities and Sciences

Electromagnetic Model (The): Wave Particle Duality Series, 1984 [also for Physics 30, Unit 4]

Format	Video (10 minutes)
Annotation	This program illustrates James Maxwell's prediction of the existence of electromagnetic waves and Heinrich Hertz's verification of their existence. It shows how the particle model was abandoned for the wave model of light behaviour.
Price	Contact distributor
Distributor	ACCESS Network VC301003

Fibre Optics, 1992

Format	Video (16 minutes)
Annotation	The technology of fibre optics enables the transmission of words, pictures and computer data over long distances through something as thin and flexible as a thread. This program examines how fibre optics work.
Price	$750
Distributor	Marlin Motion Pictures Ltd.

Interference of Light, 1991

Format: Video (18 minutes)

Annotation: The program covers:

- examples of thin film interference and diffraction
- interference of waves
- twin slits with water waves
- twin slits with coherent light
- Young's experiment—twin slits with incoherent light
- diffraction gratings
- colours of a soap bubble
- Newton's rings
- coatings on lenses
- how a compact disc works.

Price: $69

Distributor: Classroom Video

Optics: Beyond the Mechanical Universe Series, 1987

Format: Video (29 minutes)

Annotation: Maxwell's theory says that electromagnetic waves of all wavelengths, from radio waves to gamma rays and including visible light, are all basically the same phenomenon. Many of the properties of light are really just properties of waves, including reflection, refraction and diffraction. Instructional objectives are to:

- discuss the nature and properties of various parts of the electromagnetic spectrum
- state the law of reflection and Snell's law of refraction and relate them to the properties of waves
- explain wave interference and diffraction
- explain X-rays and their uses.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Particle Model (The): Wave Particle Duality Series, 1984 [also for Physics 30, Unit 4]

Format: Video (10 minutes)

Annotation: A look at the early explanations of the source and behaviour of light, from the ancient Greeks to Newton's development of the particle model. The program illustrates how this model explained geometric reflection, refraction and dispersion.

Price: Contact distributor

Distributor: ACCESS Network VC301001

Polarization of Light: Evidence of Wave: Nature of Light Series, 1988

Format: Video (24 minutes)

Annotation: This program is quite concentrated and perhaps best shown in segments. The program summary is as follows:

- generation of light
- graph of electric magnetic field strength
- reflection off conductors
- transparency off nonconductors
- travelling through cubic crystal
- rectangular lattice affecting velocity
- polaroid film, how it works
- polarization by partial reflection
- polarization of sky
- polarization of haze and milk water
- between crossed polarizing filters
- liquid crystal display (LCD)
- rotation of light by sugar solution
- cellophane between crossed polarizers
- effect of stress on plastics.

Price: $69

Distributor: Classroom Video

Polarized Light: Introductory Concepts in Physics Series, 1990

Format	Video (10 minutes)
Annotation	Polarized light is introduced through various experiments with polarizing plates; the theory of polarized light is applied to the composition of minerals.
Price	$69.95 U.S.
Distributor	Films for the Humanities and Sciences

Polarized Light and 3-D Viewing, 1987

Format	Video (30 minutes)
Annotation	Illustrates light polarization and how polarized glasses work. Supplements in-class lectures and demonstrations, and acts as an inservice training resource for teachers learning how to teach physics conceptually.
Price	Contact distributor
Distributor	ACCESS Network VC305701

Quad 7: The Wave Nature of Light: The Mechanical Universe Series, 1989

Format: Video (30 minutes each)

Annotation:

Wave Nature of Light
The work of scientists Huygens, Young and Maxwell, on the wave nature of light, is highlighted. The program outlines the properties of light, the electromagnetic spectrum and various devices, such as eyeglasses, telescopes and radar technology.

Wave–Particle Duality
This program explores the concept of the wave–particle duality of light and matter which helps to explain such phenomena as thermal radiation and the photoelectric effect.

Models of the Atom
The nature of the atom has been a subject of study for over 2000 years. Many models have been developed, particularly in the last 200 years. The program focuses on the work of Dalton Thomson, Rutherford and Bohr, who established the foundation upon which Schrödinger, de Broglie and Heisenberg developed their quantum mechanical view. This model describes the atom as a dense nucleus surrounded by an electron cloud.

Special Relativity
The theory of special relativity is described using space–time diagrams, models and examples. A brief discussion of relative mass is illustrated through an animated billiards game played in space.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Wave Model (The): Wave Particle Duality Series, 1984 [also for Physics 30, Unit 4]

Format: Video (10 minutes)

Annotation: This program examines the development of Christiaan Huygen's wave model of light behaviour, which eventually superseded Newton's particle model. It illustrates how energy is transmitted through a medium, and demonstrates Thomas Young's theory of light interference, as well as Jean Foucault's observations on the speed of light.

Price: Contact distributor

Distributor: ACCESS Network VC301002

Other Learning Resources: Physics 30

The resources identified below have not been evaluated by Alberta Education. These listings are not to be construed as an explicit or implicit departmental approval for use. They are provided as a service only to assist school authorities to identify resources that contain potentially useful ideas. The responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Note: Prices of resources are listed as provided by distributors, May 1993. Check with distributor for current rates.

Unit 1: Conservation Laws

Collisions, 1991

Format	Video (18 minutes)
Annotation	A collection of collisions from around the world is analyzed in terms of energy, force, momentum and vectors. Collisions between cars, trucks, planes, people, bats and balls, water drops and meteorites can be frozen on screen for analysis.
Price	$69
Distributor	Classroom Video

Conservation of Momentum: The Mechanical Universe Series, 1985

Format	Video (29 minutes)
Annotation	Momentum, the product of mass and velocity, is always conserved. Newton's laws involve the concept of conservation of momentum and provide powerful bases for analyzing collisions in real-life situations.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Quad 2: Conservation Laws and Fundamental Forces: The Mechanical Universe Series, 1989

Format: Video (60 minutes)

Annotation:

Conservation of Energy
What does conservation of energy mean? Galileo's experiments with balls rolling down inclined planes indicated that some quantity was conserved. Not until the nineteenth century did the law of conservation of energy emerge from experiments exploring the relationships among heat, work and energy. In this video, an overview of mechanical energy is presented. The connections among work, kinetic energy, potential energy and heat energy are explained in terms of the law of conservation of energy.

Conservation of Momentum
The idea of a mechanical Universe was set forth by René Descartes who postulated that the total "quantity of motion" in the Universe is constant. Newton later identified the quantity of motion as momentum. How his laws of motion lead to the law of conservation of momentum is covered. Not only does conservation of momentum help to explain how the mechanical Universe keeps ticking, but it also provides a way for analyzing collisions in real-life situations.

Angular Momentum
What do the motions of a spinning ice skater and that of an orbiting planet have in common? Kepler's second law of planetary motion, the equal areas law, supports the law of conservation of angular momentum. In this program, the ideas of angular momentum and torque are developed through applications to planetary motion, whirlpools, tornadoes, and spinning ice skaters.

The Fundamental of Forces
What are the fundamental forces of nature? Newton's mechanics clarified the role of forces in explaining the motion of things on Earth and in space. This program covers how all forces are manifestations of nature's fundamental forces—gravity, electricity, the weak nuclear force, the strong nuclear force.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Turning the World Inside Out, 1990 [see annotation Physics 20, Unit 1]

Unit 2: Electric Forces and Fields

Electric Battery: Beyond the Mechanical Universe Series, 1987

Format: Video (29 minutes)

Annotation: Electricity changed from a curiosity to a central concern of science and technology in 1800, when Alessandro Volta invented the electric battery. Batteries make use of the internal properties of different metals to turn chemical energy directly into electric energy. Instructional objectives are to:

- understand the internal and external potential of metals
- explain the internal workings of an electric battery.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Electric Circuits: Beyond the Mechanical Universe Series, 1987

Format: Video (29 minutes)

Annotation: Design and analysis of currents flowing in series and parallel circuits of resistors and capacitors depend not only on the laws of Ohm and Kirchhoff, but also on the work of Charles Wheatstone. Some of the instructional objectives are:

- stating the definitions of current and current density
- stating Ohm's law and distinguishing between it and the definition of resistance
- stating the relationship between potential difference, current and power
- stating the definitions of parallel and series circuit elements
- applying Kirchhoff's rules, and using them to analyze various simple direct current circuits.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Electric Currents and Circuits: Physical Science Series, 1985

Format	Video (15 minutes)
Annotation	Animation and live action experiments illustrate how energy is continually transferred by electrical currents through networks of circuits. The concepts underlying the use of circuits are: voltage, current resistance, series and parallel connections, and power. Using illustrations and examples, this presentation explains the fundamentals of electric current and circuits.
Price	$445
Distributor	Coronet Film and Video

Electric Field (The): Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	Michael Faraday's vision of lines of constant force in space provided the foundation for the modern idea of the field of force; electric fields of static charges; Gauss' law and the conservation of flux.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Electricity: Pathways Through Science Series, 1993 [also for Physics 30, Unit 3]

Format	Print ISBN 0582094070
Annotation	This module contains strategies and activities dealing with electricity. Examples of some of the investigations are electric circuits, electric fields and forces. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections. A study guide outlines main ideas for review. Some of the examples used have a British context.
Price	$69.56
Distributor	Copp Clark Pitman Ltd.

Potential and Capacitance: Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	Benjamin Franklin was the first scientist to propose a successful theory of the Leyden jar. He gave positive and negative charges their names, and invented the parallel plate capacitor. Electrical potential, the potential of charged conductors, equipotentials and capacitance are concepts discussed in the program.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Quad 5: Electric Fields and Forces: The Mechanical Universe Series, 1989

Format	Video (15 minutes)
Annotation	How does the electric force act? Coulomb suggested that the electric force, like gravity, is a force acting at a distance obeying an inverse square law. The idea of a force being transmitted without bodies in contact with one another was difficult for most eighteenth and nineteenth century scientists to accept. In the mid-nineteenth century, Michael Faraday helped resolve this dilemma by introducing the concept of an electric field. His insight provided a qualitative description of the behaviour of electric forces, which has since been interpreted mathematically.
Price	$149
Distributor	Magic Lantern Communications Ltd.

Static and Current Electricity: Physical Science Series, 1985

Format	Video (16 minutes)
Annotation	The behaviour of static and current electricity is explored through animation and live-action experiments demonstrating the causes, effects and applications of static charges and their relation to an electric current and a complete circuit.
Price	$445
Distributor	Coronet Film and Video

Static Electricity: Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	Eighteenth century electricians did not understand the interrelationship between materials and electricity, but they knew what it took to spark the interest of an audience and put on an electrifying show. This program examines Coulomb's law and the principles of static electricity.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Voltage, Energy and Force: Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	This program discusses the concepts of voltage, electrical energy and force. Instructional objectives are to: • know the definition of a gradient • state the graphical relationship between electric field lines and equipotentials • state the approximate magnitudes of voltages and forces in matter • know the explanation of how a lightning rod works • give the definition of the electron volt energy unit and the conversion between it and the joule • explain why sparks jump.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Unit 3: Magnetic Forces and Fields

Alternating Current: Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	This program examines how alternating current is generated and transported over long distances by transformers. The relationship between power transmission and voltage, as well as the effective and maximum values of voltage and current in alternating current (AC) devices, is discussed.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Electricity: Pathways Through Science Series, 1993 [see annotation Physics 30, Unit 2]

Electricity and Magnetism: Physical Science Series, 1985

Format	Video (15 minutes)
Annotation	Many devices powering our technological civilization depend on the relationship among motion, electricity and magnetism. Animation and demonstrations illustrate the applications of this relationship to motors, generators, solenoids, transformers and electromagnets; and explains the relationship between electricity and magnetism.
Price	$445
Distributor	Coronet Film and Video

Electromagnetic Induction: Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	The discoveries of Oersted and Faraday formed the foundation of the theory relating electricity to magnetism. This introduced the means by which electric power could be generated. Lenz, a physicist investigating electrical induction about the same time as Faraday, indicated that when a current is induced through a conductor, a magnetic field is set up, which interacts with the inducing field, by either attracting or repelling it. Examples of where Lenz's law applies are featured.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Electromagnetism, Part 1: Electric Fields, EM Fields, Motor Effect, 1993

Format	Video (29 minutes)
Annotation	This program shows how harnessing the principles of electromagnetism is central to a modern way of life. It examines historical experiments, explains concepts, and illustrates their application in a wide range of inventions.
Price	$69
Distributor	Classroom Video

Gravity, Electricity and Magnetism: The Mechanical Universe Series, 1986

Format	Video (30 minutes)
Annotation	The gravitational force between two masses, the electric force between two charges, and the magnetic force between two magnetic poles—all these forces take essentially the same mathematical form. The ideas developed by Newton and Maxwell, relating electricity and magnetism, are outlined. Instructional objectives are to: • understand the concept of "field", using examples • state some similarities and differences between the force of gravity and the force of electricity • explain how the speed of light is connected to the forces of electricity and magnetism.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Magnetic Field (The): Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	All magnetic fields can be thought as being produced by electric currents. The relationship between a current and the magnetic field it produces is geometrical. The Boit-Savart law, the force between electric currents, and Ampère's law, are examined.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Magnetic Fields: Experiment: Physics: Level 1 Series, 1988

Format	Video (15 minutes)
Annotation	The space around magnets is demonstrated by the following examples: the collection of iron filings with a magnet and the appearance of patterns in the filings, the movement of compass needles, changes in force direction of iron sand samples when North and South poles are alternated, and the fact that each magnet is surrounded by a three-dimensional magnetic field.
Price	$69.95 U.S.
Distributor	Films for the Humanities and Sciences

Magnets: Beyond the Mechanical Universe Series, 1987

Format	Video (29 minutes)
Annotation	William Gilbert, personal physician to Elizabeth I of England, discovered that the Earth behaves like a giant magnet. Magnetism as a natural phenomenon, the behaviour of magnetic materials and the motion of charged particles in a magnetic field are the main topics of discussion in this program.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Superconductivity Primer, 1987

Format	Print (booklet)
Annotation	This booklet discusses the concept and applications of superconductivity.
Price	$3.95 U.S.
Author	David Carroll Rudd
Distributor	KnutSoft Knowledge Systems

Ultra-strong Magnetic Fields: The World of Extremes Series, 1990

Format: Video (12 minutes)

Annotation: This program demonstrates how magnets can be divided into smaller magnets, down to the atom. The motion of electrons orbiting the nucleus, while simultaneously rotating, produces a magnetic field. An electron beam can be bent by the Lorentz force, and other ways in which strong magnetic fields affect the behaviour of electrons; the reversal of the North and South poles; turning a metal into an insulator; and other examples providing further insight into the basic properties of matter at the atomic level.

Price: $119 U.S.

Distributor: Films for the Humanities and Sciences

What Einstein Never Knew, 1985

Format: Video (50 minutes)

Annotation: Einstein's theory of relativity is an example of the development of theories in physics. As more information becomes available, Einstein's single, complete theory of the Universe may also be revised and expanded. Since Einstein, one of the most challenging puzzles to solve is how the four forces of nature (gravity, electromagnetism, the weak force and the strong force), which operate inside the nucleus of the atom, could have originated from one, single force.

In 1983, two new particles, W and Z, were discovered. These particles linked the weak force and electromagnetism. There is a current theory that also links the strong force to the other three forces, but the theory has not been verified experimentally. New discoveries may prove that the Universe is, in fact, multidimensional rather than consisting of only four dimensions. If so, current theories will progress by being revised and expanded in the coming years.

Price: $575

Distributor: BBC Enterprises

Unit 4: Nature of Matter

Atom (The): Beyond the Mechanical Universe Series, 1987

Format: Video (29 minutes)

Annotation: This program explores the history of the atom, from the ancient Greeks to the early twentieth century, when discoveries by J. J. Thomson and Ernest Rutherford changed the model of the atom. Instructional objectives are to:

- summarize the kinetic theory and discuss the size of atoms
- compare Thomson's model of an atom with Rutherford's planetary model of an atom
- discuss why Rutherford's model of an atom conflicted with Maxwell's theory of charged particles
- discuss the significance of Brownian motion in providing evidence for the existence of atoms.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Atomic Particles: Women in Science Series, 1991

Format: Video (22 minutes)

Annotation: Helen Lindquist is a physicist who oversees experiments to determine the capabilities of a new atomic energy accelerator. She stresses that, with commitment, anyone can attain a career in the sciences. Kim Tremblay is a technologist involved in the innovative new technique of bubble technology. She cites curiosity and desire to see a project through as prerequisites for scientific work.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Bohr Model (The): Structure of the Atom Series, 1985

Format: Video (10 minutes)

Annotation: This program introduces Niels Bohr, who improved upon Rutherford's model of the atom, and explained quantized energies, orbit radii, and electron velocities, concluding that electrons may occupy only certain precise orbits, or energy levels. It shows how Bohr was able to predict the speed and energy of an electron in each orbit.

Price: Contact distributor

Distributor: ACCESS Network VC301104

Can We Use It? The Story of Radiation Series, 1981

Format	Video (15 minutes)
Annotation	The problem of evaluating the risks and benefits associated with radiation is examined. The program shows how many risks are accepted in everyday life and illustrates the problem of evaluating risks and benefits in different technologies. The question is posed as to how risks are determined to be acceptable and how benefits justify a risk.
Price	Contact distributor
Distributor	Visual Education Centre

Cold Fusion, 1990

Format	Video (50 minutes)
Annotation	Scientists Martin Fleischmann and Stanley Pons held a press conference in March of 1989 to announce that they had harnessed, at room temperature, the nuclear fusion process that powers the Sun. This is the cautionary story of how a revolutionary claim by two scientists was taken up by the media and their own university, tempted by a vision of cheap, clean and inexhaustible energy.
Price	$575
Distributor	BBC Enterprises

Discovery of Radioactivity (The): Nuclear Physics Series, 1986

Format	Video (10 minutes)
Annotation	This program explores the nature of radioactivity and presents an historical overview of the scientific developments that lead to its discovery. It examines the research of Faraday, Röntgen and the Curies; and highlights Becquerel's discovery of radioactivity.
Price	Contact distributor
Distributor	ACCESS Network VC301301

Does It Affect Us? The Story of Radiation Series, 1981

Format — Video (15 minutes)

Annotation — Genetic and somatic effects of radioactivity are defined. The difference in background exposure for different locations across the United States is given. The program shows that exposure to radioactivity includes natural background from radioisotopes, such as radon in building materials, as well as exposures resulting from medical and dental diagnostics. Tolerance differences to radiation, by various organs of the body, are described.

Price — Contact distributor

Distributor — Visual Education Centre

Earliest Models (The): Structure of the Atom Series, 1985

Format — Video (10 minutes)

Annotation — Examines the developments in the study of the atom throughout the ages. Reviews 2000 years of experiments that lead up to the modern atom model. Mentions such scientists as Democritus, Roger Bacon, William Gilbert, Niccolo Cabeo, Benjamin Franklin, Charles Augustin de Coulomb, Antoine Lavoisier and Joseph Proust.

Price — Contact distributor

Distributor — ACCESS Network VC301101

Electrical Energy from Fission: Nuclear Physics Series, 1986

Format — Video (10 minutes)

Annotation — Reviews how nuclear fission can lead to chain reactions, controlled and harnessed in nuclear reactors. Outlines the functioning of a nuclear reactor. Shows how energy is produced and transmitted as electricity.

Price — Contact distributor

Distributor — ACCESS Network VC301305

Electromagnetic Model (The): Wave Particle Duality Series, 1984 [see annotation Physics 20, Unit 4]

Electron Arrangement: Electron Arrangement and Bonding Series, 1984

Format: Video (10 minutes)

Annotation: When physicists Erwin Schrödinger and Werner Heisenberg applied wave mechanics to the atom, they theorized that Bohr's energy levels consisted of sublevels, or orbitals. This program relates the importance of the number of electrons in the outer orbitals to the properties of the atom.

Price: Contact distributor

Distributor: ACCESS Network VC289303

Electron Arrangement in Atoms, 1991

Format: Video (27 minutes)

Annotation: The arrangement of electrons in atoms determines their chemistry and behaviour. The following concepts are summarized:

- ionization of atoms by electron bombardment
- light emission from hot electrons in atoms
- the hydrogen spectrum
- electron diffraction
- quantum mechanical model
- the Schrödinger wave equation
- spatial orbital models and molecular geometry.

Price: $69

Distributor: Classroom Video

Energy from the Nucleus: Nuclear Physics Series, 1986

Format: Video (10 minutes)

Annotation: Examines the process of radioactive decay and how Einstein's theory of relativity applies to different situations. Uses simulations to recreate the conversion of mass to energy in nuclear fission and fusion.

Price: Contact distributor

Distributor: ACCESS Network VC301304

Four Forces of Nature (The): Science Show Series, 1990

Format: Video (26 minutes)

Annotation: Scientists have been trying to probe the inner structure of matter to lay the foundation for a unified theory of the four basic forces responsible for universal equilibrium—gravity, electromagnetic force, radioactivity and nuclear force. Without a full understanding of these forces, humankind has learned to make use of them for numerous purposes, from energy production to medical procedures. Experiments carried out in major physics laboratories throughout the world may enable physicists to fulfill their ultimate objective: a unifying theory describing the four major forces, a single equation theory encompassing all of the physical phenomena found in the Universe.

Price: $250

Distributor: Le Groupe Multimédia du Canada

Introducing the Players, 1984

Format: Video (10 minutes)

Annotation: This program is an introduction to the atom and the three main subatomic particles: the electron, the proton and the neutron. The location, charge and relative mass of these particles are demonstrated. Ernest Rutherford's model of the atom is reviewed in terms of its advances and shortcomings.

Price: Contact distributor

Distributor: ACCESS Network VC289301

Is It Safe? The Story of Radiation Series, 1981

Format: Video (15 minutes)

Annotation: A risk-benefit analysis of human exposure to nuclear radiation and chemical compounds are compared and linked to an increased incidence of cancer. Methods for predicting the rate of occurrence of cancer are summarized.

Price: Contact distributor

Distributor: Visual Education Centre

Matter Waves: Wave Particle Duality Series, 1984

Format	Video (10 minutes)
Annotation	This program examines Louis de Broglie's prediction that particles sometimes behave like waves, and looks at the conditions under which this occurs. It shows the difference between photons and electrons, and illustrates the need of both the wave and particle models to explain the behaviour of electromagnetic radiation.
Price	Contact distributor
Distributor	ACCESS Network VC301006

Natural Transmutations: Nuclear Physics Series, 1986

Format	Video (10 minutes)
Annotation	Demonstrates how elements at the atomic level are transformed into isotopes through the process of decay. Explains three types of radioactive decay as well as the concept of half-life.
Price	Contact distributor
Distributor	ACCESS Network VC301303

Nature of Radioactivity (The): Experiment Physics: Level 2 Series, 1988

Format	Video (15 minutes)
Annotation	This program examines the years between Hiroshima and Chernobyl, from the promises made for nuclear power to antinuclear pickets. It shows how simpler elements are constituted and why some heavier ones are unstable; explains the four kinds of radiation, how they work, and where they appear in nature; and why radon gas poses such danger. Humankind has evolved on a radioactive planet, eats radioactive food, lives in radioactive houses. The real dangers of additional radiation from weapons testing and nuclear power plant emissions are examined.
Price	$149 U.S.
Distributor	Films for the Humanities and Sciences

Niels Bohr, 1991

Format	Video (15 minutes)
Annotation	This program documents Niels Bohr's life, his institute, and his work in unravelling the structure of the atom, laying the groundwork for the atomic bomb, and seeking to prevent its use.
Price	$149 U.S.
Distributor	Films for the Humanities and Sciences

Nuclear By-products: Nuclear Physics Series, 1986

Format	Video (10 minutes)
Annotation	Illustrates the fission process in the core of a reactor, with emphasis on the dual nature of the by-products. Discusses the long life of nuclear waste products, the difficulty of their disposal, and the drawbacks of nuclear reactors as sources of energy.
Price	Contact distributor
Distributor	ACCESS Network VC301306

Nuclear Energy, 1990

Format	Video (23 minutes)
Annotation	This program examines the processes of fission and fusion, by which energy can be produced, using uranium or even water. Nuclear energy is also used to save lives, through radiation therapy; and to prolong the length of time that foods can be preserved, through irradiation.
Price	$250
Distributor	Le Groupe Multimédia du Canada

Nuclear Physics, 1991

Format: Video (22 minutes)

Annotation: Program features include:

- models of the nucleus
- density of the nucleus
- atomic mass unit based on carbon 12
- isotopes—variation of neutrons
- nuclear force
- radioactivity
- ionizing radiation—alpha, beta, gamma
- half-life
- beta decay—neutron turning into a proton
- alpha decay
- gamma decay
- nucleons made of quarks
- uranium decay series.

Price: $69

Distributor: Classroom Video

Nuclear Physics, 1992

Format: Print ISBN 0333466586

Annotation: The book deals with the discovery of the atomic nucleus, the physics of nuclear processes and nuclear technology. Features include:

- promotion of interactive learning through assignments
- clear organization of text into sections, chapters and themes
- many questions, including potential examination questions with answers, which can be accessed and modified to suit class needs
- learning objectives and summaries at the start and end of chapters
- illustrations and photography
- use of standard nomenclature, symbols and units.

Price: $17.95

Author: David Sang

Distributor: Nelson Canada

Nuclear Science: Women in Science Series, 1991

Format: Video (22 minutes)

Annotation: Bibianne Slade, an engineer, is the world's only licenced female nuclear reactor operator. She views her career as fascinating, challenging and open to anyone with an interest in the physical sciences. Sheila Boutcher, after raising a family, resumed a career in science, returning to school to become a nuclear medicine technologist.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Nuclear Waste Management: Science Screen Report Series, 1988

Format: Video (16 minutes)

Annotation: What is nuclear energy? What is the difference between fission and fusion? Can the by-products of nuclear waste be disposed of safely? The importance of nuclear waste management is addressed, and many of the questions about this energy alternative to fossil fuels are examined.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Particle Model (The): Wave Particle Duality Series, 1984 [see annotation Physics 20, Unit 4]

Photons: Wave Particle Duality Series, 1984

Format: Video (10 minutes)

Annotation: Illustrates the role of both the particle and the wave models in explaining the behaviour of light. Demonstrates how the work of Arthur Compton and Geoffrey Taylor reinforced each of these models.

Price: Contact distributor

Distributor: ACCESS Network VC301005

Properties of Becquerel Rays: Nuclear Physics Series, 1986

Format	Video (10 minutes)
Annotation	Recreates the discovery of Becquerel rays and their properties and the Curies' experiments with radioactive sources. Shows how Rutherford's experiments illustrate the properties of three types of radiation—alpha, beta and gamma.
Price	Contact distributor
Distributor	ACCESS Network VC301302

Quantum Idea (The): Wave Particle Duality Series, 1984

Format	Video (10 minutes)
Annotation	This program examines Max Planck's theory of energy emission as bundles, which he called quanta, and at Albert Einstein's explanation of the photoelectric effect. It describes how the discoveries lead scientists to use both the particle and wave models to describe the behaviour of light.
Price	Contact distributor
Distributor	ACCESS Network VC301004

Radioactivity: Science Topics, 1985

Format	Video (20 minutes)
Annotation	This program looks at the causes and effects of radioactivity. It shows how the properties of different types of radioactivity affect their use in many different fields, from radioactive tracing to medicine.
Price	$349
Distributor	BBC Enterprises

Rutherford Model (The): Structure of the Atom Series, 1985

Format	Video (10 minutes)
Annotation	This program examines Rutherford's contributions to atomic theory, and his use of radioactivity to probe the atom. It shows how he created a model of the atom that imitated the structure of the solar system.
Price	Contact distributor
Distributor	ACCESS Network VC301103

Rutherford Scattering of Alpha Particles: Experiment: Physics: Level 2 Series, 1987

Format	Video (15 minutes)
Annotation	The experimental observations leading to the development of the Rutherford model of the atom are reproduced in this program. The number and energy of particles scattered at different angles from bombarded thin foils of different pure materials are recorded.
Price	$119 U.S.
Distributor	Films for the Humanities and Sciences

Rutherford–Bohr Atom (The): Electron Arrangement and Bonding Series, 1984

Format	Video (10 minutes)
Annotation	With his concept of energy levels, Bohr saved Rutherford's model of the atom. This program explores Bohr's hypothesis that electrons can occupy only definite energy levels. The transfer of electrons between energy levels and the relationship between the properties of an atom and its electron arrangement are discussed.
Price	Contact distributor
Distributor	ACCESS Network VC289302

Science, Technology and Society, 1992

Format	Print ISBN 0748712933
Annotation	A resource pack with a wide range of topics, exercises and assignments involving current issues in environmental science, human biology, and other general science areas. Issues are addressed through up-to-date information, illustrations and statistics. Recent scientific advances are investigated through real-life case studies. British examples are used in some of the discussion on science issues.
Price	$77.20
Author	David Andrews
Distributor	Copp Clark Pitman Ltd.

Sheldon Glashow: Unifying Forces: Nobel Prize Series, 1990

Format	Video (20 minutes)
Annotation	Sheldon Glashow, the theoretician, received the Nobel Prize in physics in 1979. He theorizes about the nature of the very small particles that make up protons and neutrons, and the forces that hold these particles together. He thinks about what causes the nucleus of an atom to remain together. Glashow does not perform experiments but he often makes suggestions to other physicists about experiments they might try. His primary motivation for such work is "to bring us closer to an ultimate understanding of nature."
Price	$69
Distributor	Sunburst Communications Inc.

Smaller than the Smallest: Structure of the Atom Series, 1985

Format	Video (10 minutes)
Annotation	This program explains Dalton's chemical atomic theory and how it supports Proust's law of definite proportions. Experiments conducted by physicists Faraday, Crookes, Thomson and Millikan are shown.
Price	Contact distributor
Distributor	ACCESS Network VC301102

Spectra: Structure of the Atom Series, 1985

Format	Video (10 minutes)
Annotation	Examines Bohr's revolutionary proposals that brought atomic structure into the realm of quantum physics. Shows how Bohr was able to predict all frequencies of radiation for the hydrogen atom, using spectroanalysis. Points out the defect of his model, which could not predict the behaviour of more complex atoms.
Price	Contact distributor
Distributor	ACCESS Network VC301105

Wave Mechanical Model (The): Structure of the Atom Series, 1985

Format: Video (10 minutes)

Annotation: This program highlights how Louis Victor de Broglie speculated on the wave nature of matter and thus predicted the allowable orbits and radii of atoms. It explains how this is key to understanding the behaviour of multielectron atoms and multiatom compounds and establishes the wave-mechanical model, which is still accepted.

Price: Contact distributor

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Wave Model (The): Wave Particle Duality Series, 1984 [see annotation Physics 20, Unit 4]

What Does It Do? The Story of Radiation Series, 1981

Format: Video (15 minutes)

Annotation: This program describes what happens when radiation enters and interacts with matter. How the various types of radiation, such as alpha and beta particles penetrate different distances into matter, are discussed. Isotopes, radioisotopes, neutron capture and neutron activation analysis, are defined.

Price: Contact distributor

Distributor: Visual Education Centre

What Effect Does It Have? The Story of Radiation Series, 1981

Format: Video (15 minutes)

Annotation: This program shows how all life is composed of cells and can be affected by radiation. It demonstrates that radiation damage to cells can cause biological changes affecting the organism and its later generations. Differences in cell damage from beta and alpha radiation are described, as well as the difficulty in measuring cell damage from low doses of radiation.

Price: Contact distributor

Distributor: Visual Education Centre

What Is It? The Story of Radiation Series, 1981

Format	Video (15 minutes)
Annotation	Alpha, beta and gamma radiation are described, as well as the position of gamma radiation and X-rays in the electromagnetic spectrum. The sources of radiation exposure from natural background and human-made radioactivity are examined.
Price	Contact distributor
Distributor	Visual Education Centre

What Is It Made Of? The Story of Radiation Series, 1981

Format	Video (15 minutes)
Annotation	An historical discussion of how radiation was discovered, studied and used in the first nuclear reactor is presented. The constituents of the nucleus, the ground and excited states of nuclei are described.
Price	Contact distributor
Distributor	Visual Education Centre

What Is Radioactivity? 1990

Format	Video (16 minutes)
Annotation	In 1938, the discovery of nuclear fission enabled scientists to create radioactive energy artificially, releasing radioactive products capable of causing permanent damage to human health and the environment. This program uses animation to illustrate how the different kinds of radioactive rays can penetrate and affect the human body, and the benefits and dangers of artificially produced radioactivity.
Price	$750
Distributor	Marlin Motion Pictures Ltd.

Where Is It? The Story of Radiation Series, 1981

Format	Video (15 minutes)
Annotation	Instruments for detecting and monitoring radiation, such as Geiger counters, ion chambers, scintillation detectors and thermoluminescent detectors, are shown.
Price	Contact distributor
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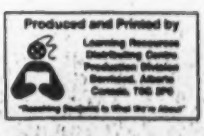

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